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ABSTRACT

Designed to accompany an all-day "brain" workshop on neurological aspects of learning, the manual contains charts and illustrations depicting the role and function of the right and left hemispheres. Additional material addresses such topics as physiological evolution of the brain, disharmony between left/right brain functions, comparisons between the human brain and computers, age and brain development, sex and brain functioning, and the integration of both brains in the creative process. A narrative section comments on the rationale for stimulating right brain processes in education and proposes an approach to stimulate right brain processes. The model includes rationales and descriptions of three types of activities: physical sensory, affective-attitudinal-cognitive, and formal instructional. (CL)

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THE BRAIN OWNER'S MANUAL

A WORKSHOP ON
HOW TO REACH YOUR
PERSONAL BEST THROUGH
A WHOLE MIND APPROACH

by

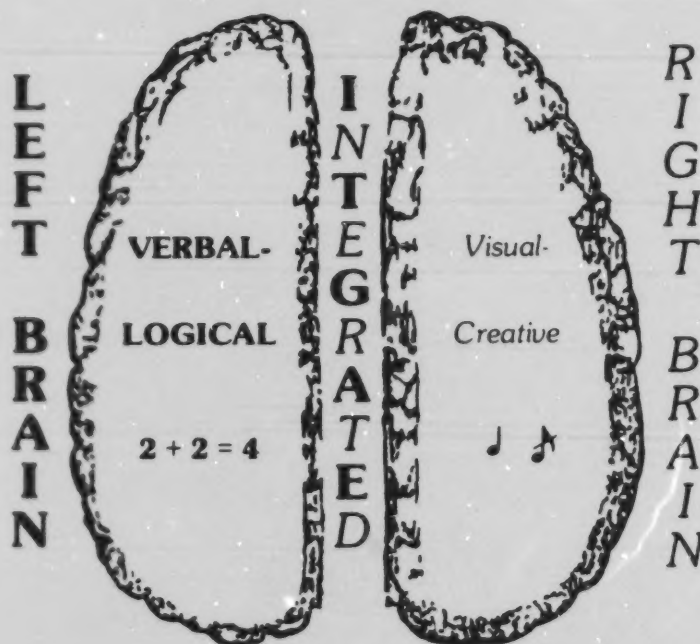
Dr. Ronald L. Rubenzer
&
Donna O. Rubenzer

Revised Edition 1984

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LEARN EFFECTIVE METHODS TO BALANCE AND USE BOTH
SIDES OF THINKING TO INCREASE YOUR THINKING POWER

To be used in the Brain Workshop

©Dr. Ronald L. Rubenzer

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PURPOSE OF THE MANUAL

BY USING THIS STREAMLINED, VISUALLY ILLUSTRATED PRIMER WITH THE "HANDS ON" BRAIN WORKSHOP, YOU WILL MORE FULLY UNDERSTAND WHY STUDYING THE BRAIN IS VITALLY IMPORTANT. YOU WILL BE ABLE TO RECOGNIZE LEFT AND RIGHT BRAIN TYPES OF THINKING AND YOU WILL LEARN HOW TO "REACH YOUR PERSONAL BEST" BY INTELLIGENTLY USING AND BALANCING BOTH LEFT AND RIGHT SIDES OF THINKING.

THIS WORKSHOP MANUAL IS BASED ON A CRITICAL REVIEW AND INTERPRETATION OF 20 YEARS OF BRAIN RESEARCH WHICH IS PRESENTED IN THE CEC/ERIC MONOGRAPH EDUCATING THE OTHER HALF: IMPLICATIONS OF LEFT/RIGHT BRAIN RESEARCH (2ND PRINTING, 44 PAGES, \$4.00, STOCK NO. 264). IT IS AVAILABLE FROM CEC/ERIC PUBLICATION SALES, 1920 ASSOCIATION DRIVE, RESTON VIRGINIA, 22091-1589.

THE AUTHORS

DR. RONALD AND DONNA RUBENZER HAVE, OVER THE PAST FIVE YEARS, CONSULTED TO MORE THAN 50 INSTITUTES INCLUDING THE UNITED NATIONS (NEW YORK), SEVERAL UNIVERSITIES AND STATE DEPARTMENTS OF EDUCATION AND HAVE APPEARED ON LOCAL TELEVISION NETWORKS ON THE EAST COAST AND SOUTHWEST. DR. RUBENZER RECEIVED A NATIONAL RESEARCH AWARD FOR HIS WORK ON LEFT/RIGHT BRAIN IN 1979 AND DONNA RUBENZER HAS BEEN A CURRICULUM CONSULTANT FOR FIVE YEARS. SHE HAS DEVELOPED A SUCCESSFUL CURRICULUM GUIDE ENTITLED ARTISTIC EXPRESSION THROUGH RIGHT BRAIN ACTIVITIES. THEY ARE CURRENTLY WRITING A BOOK ON THE PRACTICAL APPLICATIONS OF BRAIN RESEARCH IN BUSINESS.

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SCHEDULE OF EVENTS
CAN THE BRAIN UNDERSTAND ITSELF?

By
Dr. Ronald L. Rubenzer
and
Donna O. Rubenzer

Topics	Related Activities
. Introduction and Overview: Why study the brain; how to practically apply what is known.	Distribute visually illustrated Brain Owner's Manual.
. What is Your Preferred Style of Thinking?	Survey and analysis of your thinking style.
. Evolution of the Brain	A brief look at a <u>half billion</u> years of evolution.
. Thinking about Thinking: The "divisions of labor" of the left and right brains.	A live demonstration of how your left and right brains work differently.
. The Neglected Side of Thinking: The right brain's role in the arts, language, reading, memory, creative writing and sports performance.	Exercises to "wake up" your right brain; your "silent partner" in thinking productively.
. Your Brain and You: The influences of age, handedness, stress, environment and work demands.	An activity to determine your true dominance. You may be surprised! A relaxation exercise.
. The "Gender Gap"?: The sex-linked differences in the brain's operation.	A discussion of advantages and disadvantages of each style.
. A Marriage of Opposites: What research says about how the two brains communicate and how people of opposite thinking styles interact.	A demonstration of how people with different thinking styles can complement each other.

- . **Breakthroughs in the Diagnosis and Treatment of Learning and Emotional Disorders.**
A simulation exercise of what it is like to be a RIGHT BRAIN individual in a LEFT BRAIN world.
- . **Food for Thought:**
The effects of diet, drugs (caffeine, alcohol, nicotine, and others) and vitamins on the health and functioning of the brain.
A presentation of benefits and hazards of the ALL AMERICAN LEFT and RIGHT BRAIN DRUGS.
- . **Your Truly Personal Computer:**
The similarities and differences between human and mechanical brains.
Activities to overcome COMPUTER PHOBIA or how to make any computer friendly.
- . **Battle of the Brains:**
What styles of thinking are better for different tasks.
How to shift or integrate thinking styles.
Experiences which will integrate left and right brain thinking.
- . **The Whole Mind Goes to Work:**
How to improve performance in school, business, communication and decision making by using your whole mind.
A presentation of proven methods to use the whole brain in management, teaching, learning and motivation; Brain Owner's Manual.
- . **Improving the 99% Perspiration/ 1% Inspiration - Creativity Formula**
The CREATE principle, a step-by-step method to increase your problem solving skills.
An overview of numerous examples of how creative geniuses use their brains differently.

CAN THE BRAIN UNDERSTAND ITSELF?

By Dr. Ronald L. Rubenzer and Donna O. Rubenzer
Presession Awareness Survey

1. How many brain cells does the average brain contain?
2. How old is the human brain as we know it?
3. How fast does the human brain grow during its prenatal development?
4. What would the size of a computer with the same capacity as the brain have to be?
5. What is the amount of electrical energy the brain is constantly generating?
6. Until what age does the brain continue to grow in complexity?
7. What is the average verbal mental age of the right brain?
8. What is the average judgment capacity (expressed in years) of the right brain?
9. One out of how many adults is right brained?
10. What are some right brain professions?
11. What is the major distinction in the brain processing patterns of a truly creative genius in comparison to those of less creative status?
12. Name one method of directly stimulating the right brain and one indirect method of enhancing right brain processing.

BONUS QUESTION: What type of brain processing (left or right) is emphasized primarily in education today?

WHY STUDY THE BRAIN?

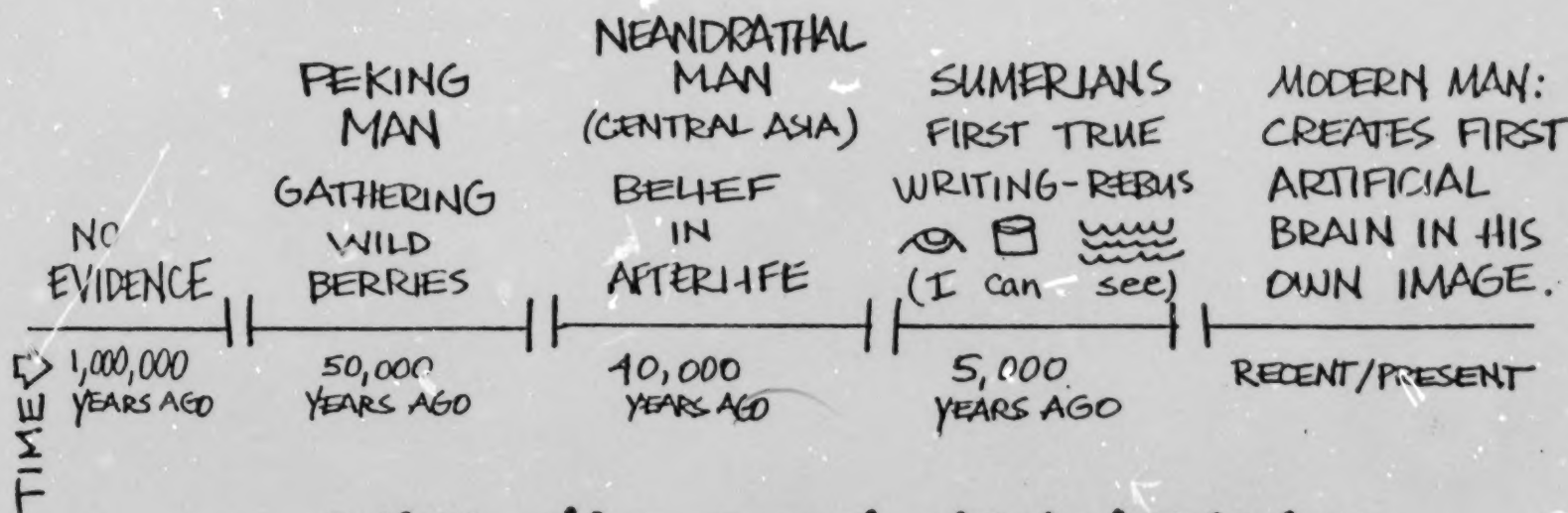
CONSIDERING THAT HUMAN FOLLY AND HUMAN MADNESS ARE THE GREATEST DANGERS TO HUMAN CIVILIZATION AND EVEN, PERHAPS, TO HUMAN EXISTENCE, IT IS EXTREMELY IMPORTANT THAT WE LEARN TO UNDERSTAND THE HUMAN BRAIN IN DETAIL. SURELY WE SHOULD LEARN TO DEAL WITH ITS MALFUNCTIONING ON AT LEAST THE SAME LEVEL OF UNDERSTANDING AS WE DEAL WITH THE MALFUNCTIONS OF OTHER HUMAN ORGANS.

RELEVANCY OF LEFT/RIGHT BRAIN RESEARCH

1. BYPASS MOST OF THE CONTAMINATING FACTORS IN CURRENT ABILITY ASSESSMENT.
2. CONSTRUCT MODELS OF INTELLECTUAL FUNCTIONING WHICH ARE BASED ON HIGHLY VALID AND RELIABLE PHYSIOLOGICAL MEASURES.
3. RELATE BRAIN STRUCTURE TO INFORMATION PROCESSING, SO THAT MORE APPROPRIATE PRESCRIPTIVE TEACHING CAN RESULT AS A FUNCTION OF DIAGNOSTICS.
4. THE USE OF "NEUROMETRICS" TO INVESTIGATE THE CAUSES OF SIGNIFICANT INTELLECTUAL OR EMOTIONAL IMPAIRMENT (JUST AS EKG'S ARE USED NOW FOR "POTENTIAL" HEART DISEASE PATIENTS).
5. MORE ACCURATELY REPLICATE THE MENTAL PROCESSES OF TRULY CREATIVE AND PRODUCTIVE INDIVIDUALS.

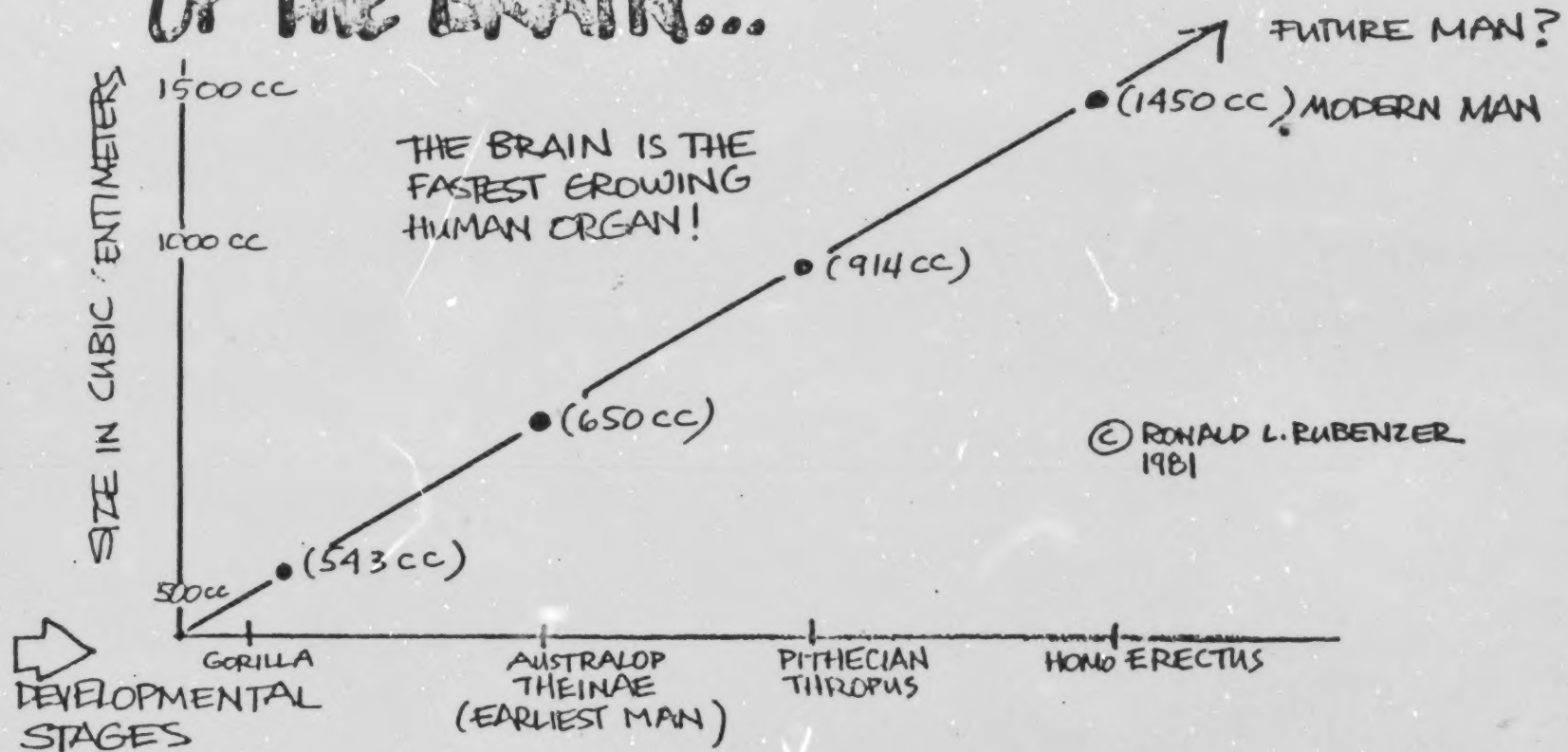
(Rubenzer, 1981)

EVIDENCE OF LEFT HEMISPHERE DEVELOPMENT - AS REFLECTED BY ARTIFACTS...



MAN HAS BEEN NON VERBAL
FOR 99.995% OF HIS EXISTENCE

THE PHYSIOLOGICAL EVOLUTION OF THE BRAIN...



THE BRAIN HAS INCREASED IN SIZE BY 250% FROM THE EARLIEST MAN'S BRAIN. IT DOUBLES IN SIZE EVERY 400,000 YEARS. WILL THIS GROWTH CONTINUE?

(Rubenzer, 1981)

LEFT

WORDFULL

ANALYTIC

LINEAR

COGNITIVE

Right

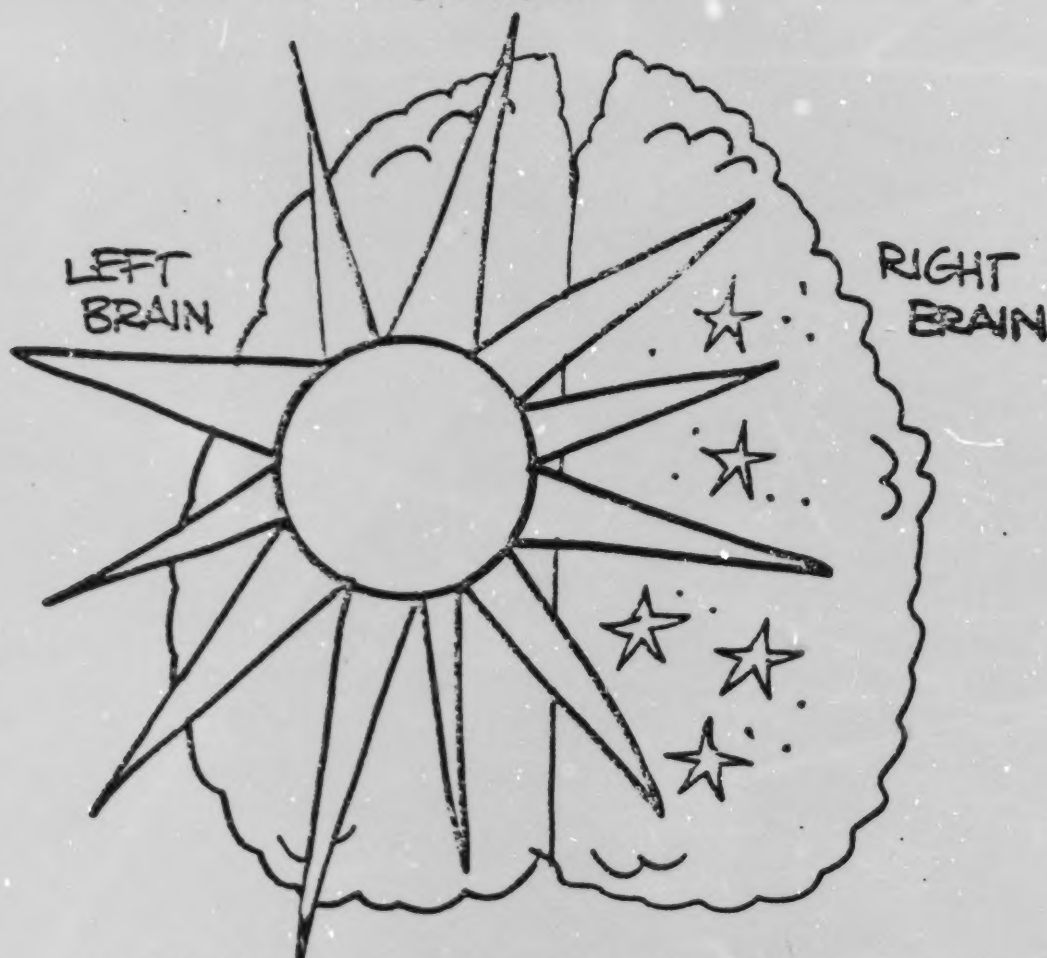
Wordless

Analogic

Creative

Affective

THE RELATIONSHIP BETWEEN THE LEFT AND RIGHT BRAIN FUNCTIONS...



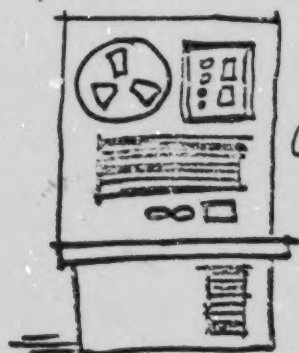
ALTHOUGH THE RIGHT BRAIN FUNCTIONS ARE ALWAYS OCCURRING, THEY ARE DOMINATED BY THE LEFT BRAIN FUNCTIONS, JUST AS THE SUN OBSCURES THE PRESENCE OF THE OTHER STARS IN THE SKY DURING THE DAY. (Rubenzer, 1981)

DISHARMONY BETWEEN LEFT AND RIGHT BRAIN FUNCTIONS

DUE TO FUNCTIONAL AND EDUCATIONAL FACTORS THE LEFT BRAIN IS GENERALLY FUNCTIONING AT THE ADULT LEVEL. WHEREAS, THE RIGHT BRAIN FUNCTIONS AT ABOUT A 5 YEAR OLD LEVEL FOR JUDGMENT, AND AN EARLY ADOLESCENT (13 YEAR OLD) LEVEL IN VERBAL AND SPATIAL REASONING (LEITER, 1975).

(Rubenzer 1981)

THE HUMAN BRAIN AND THE COMPUTER: SIMILARITIES AND DIFFERENCES...



COMPUTER



BRAIN

BINARY

- CAN DO LONG AND INTRICATE ARITHMETIC CALCULATIONS.
- CAN PROVIDE IMMEDIATE CORRECT ANSWERS... CONVERGENT THINKING

- LESS PRECISE METHODS OF SIGNALING BUT CAN ADJUST THE NUMBER AND EFFICIENCY AT ITS SYNAPSES
- CAN RECOGNIZE PATTERNS IN WAYS NO COMPUTER CAN BEGIN TO APPROACH.
- CAN RECOMBINE KNOWN FACTS IN NOVEL AND UNIQUE WAYS.

COMPUTERS CAN PERFORM ALMOST ALL LEFT BRAIN FUNCTIONS AT A NEARLY INFINITELY MORE RAPID PACE THAN THE HUMAN BRAIN. EDUCATION SHOULD EMPHASIZE RIGHT SKILLS WHICH TRANSCEND AND COMPLEMENT WHAT COMPUTERS CAN PRESENTLY DO.

LEFTIES ON THE JOB

THE PROPORTION OF LEFT-HANDED INDIVIDUALS IN "RIGHT BRAIN" PROFESSIONS SUCH AS ACTING, ARCHITECTURE, MUSIC AND ART, IS DOUBLE THE NORMAL EXPECTANCY.

THIS FINDING STRONGLY SUPPORTS THE CONTRALATERALITY OF FUNCTION PRINCIPLE (RIGHT BRAIN CONTROLS THE LEFT SIDE OF THE BODY).

UNTIL WHAT AGE DOES THE BRAIN CONTINUE TO GROW?

MYELONIZATION IN THE POSTERIOR INTRINSIC AREA OF THE BRAIN

(RESPONSIBLE FOR THE INTEGRATION OF INFORMATION) CONTINUES

INTO THE 40'S.

MYELONIZATION IN GENERAL CONTINUES UNTIL THE 60'S.

(WESTBEE 1980)

HOW DOES SEX RELATED BRAIN

DOMINANCE AFFECT BEHAVIOR

FOR FEMALES THE TWO INTIMATELY CONNECTED HEMISPHERES OF THE FEMALE BRAIN WOULD COMMUNICATE MORE RAPIDLY -- AN ADVANTAGE IN INTEGRATING ALL THE DETAIL AND NUANCE IN AN INTRICATE SITUATION -- BUT A DISADVANTAGE WHEN IT COMES TO HOMING IN ON A FEW DETAILS.

MALES

WITH LESS INTERFERENCE FROM THE LEFT HEMISPHERE, A MAN COULD USE HIS RIGHT HEMISPHERE MORE PRECISELY IN DECIPHERING A MAP OR FINDING A THREE DIMENSIONAL OBJECT IN A TWO DIMENSIONAL REPRESENTATION.

(LEVY 1981)

VIVA LA DIFFERENCE!

(RELATIVE STRENGTHS OR DOMINANCE)



SPATIAL REASONING ~ VERBAL REASONING

GROSS TOTAL BODY ~ FINE MOTOR TASKS
MOVEMENTS REQUIRING
FAST REACTION TIME

SOCIAL & NONSOCIAL ~ SOCIAL STIMULI
STIMULI EQUALLY
COMPETE DOMINATE OVER
NON-SOCIAL

THE LEFT/RIGHT BRAIN MATRIX: SOME REPRESENTATIVE GENERALIZATIONS
 BY RONALD L. RUBENZER, ALBUQUERQUE, NEW MEXICO © 1980

PREDOMINANT HEMISPHERIC MODE	LEFT	INTELLECTIVE AFFECTIVE	RIGHT
1. * EEG PATTERNS	BETA 14-40 CYCLES/SEC (HZ)	ALPHA TO THETA (8-13 HZ) TO (3.5 - 7.5 HZ)	LOW ALPHA-THETA-DELTA (8-13 HZ) (3.5-7.5 HZ) (.5 to 3.0 HZ)
2. PERCENT OF TIME	60%	5%	35%
3. DIRECT STIMULA- TION	PHYSICAL ACTIVITY (CARDIO- VASCULAR)	DEEP RELAXATION THROUGH RELAXA- TION TRAINING (BIOFEEDBACK OR AUTOGENIC)	DEEP RELAXATION (BIO- FEEDBACK) AND NORMAL SLEEP
4. AFFECTIVE CORRELATES	ALERT, EXCITED, ANXIOUS	RELAXED, AWARE, INTEGRATED	PLEASANT, DREAMING; CONFUSED
5. COGNITIVE STYLES	ANALYZES OVER TIME (VERBALLY)	SYNTHESIZES OVER SPACE (VISUALLY- SPATIALLY)	SYNTHESIZES OVER SPACE (VISUALLY, SPATIALLY) AND RANDOM
6. ACADEMIC CORRELATES	READING WRITING ARITHMETIC	POETRY, SINGING, DRAMA, ART, PHYSICAL EDUC.	ART, PHYSICAL EDUCATION
7. WALLIS'S CREATIVITY STAGES	PREPARATION VERIFICATION	ILLUMINATION (THE "AH-HA" EXPERIENCE)	INCUBATION
8. SOI OPERATIONS	COGNITION MEMORY, CONVERGENT PRODUCTION EVALUATION	DIVERGENT PRODUCTION (SOME CONVERGENT- VISUAL)	DIVERGENT PRODUCTION
9. REFERENCES	MEEKER SOI WORKBOOKS AND MOST EDUCATIONAL TEXTS	MEEKER-SOI WORK- BOOKS PARNES, ET AL - GUIDE TO CREA- TIVE ACTION DE BONO-THE USE OF LATERAL THINKING HENDRICKS-THE CENTERING BOOK	EDWARDS-DRAWING ON THE RIGHT SIDE OF THE BRAIN

*NUMBERS DENOTE
REFERENCES. SEE
BACK PAGE.

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CLASSIFICATION OF STRUCTURE OF INTELLECT CELLS ACCORDING TO LEFT/RIGHT BRAIN PROCESSING

© RONALD L. RUBENZER
DEPARTMENT OF SPECIAL EDUCATION
UNIVERSITY OF NEW MEXICO
1981

EMPHASIS NEEDED →			
25 LEFT BRAIN ACTIVITIES	PREDOMINANTLY LEFT BRAIN SOI CELLS 32 (35%)	LEFT BRAIN WITH SOME RIGHT BRAIN INVOLVEMENT 40 (44%)	RIGHT BRAIN WITH SOME LEFT BRAIN INVOLVEMENT 16 (17%)
		Integrated	Right Brain
			PREDOMINANTLY RIGHT BRAIN SOI CELLS 2 (3%)
			22 26

LEFT RIGHT BRAIN CLASSIFICATION OF THE 90 STRUCTURE OF INTELLECT CELLS

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DEPARTMENT OF SPECIAL EDUCATION
UNIVERSITY OF NEW MEXICO

I. LEFT BRAIN CLASSIFICATION

SOI OPERATION	PREDOMINANTLY LEFT BRAIN ACTIVITIES		LEFT BRAIN WITH SOME RIGHT BRAIN ACTIVITIES	
COGNITION (c)	CSU	CSR	CFU	CST
	CMU	CMR	CFC	CMT
	CSU	CSS	CFR	CSI
	CMC	CMS	CFS	CMI
MEMORY (c)	MSU	MSR	MFU	MST
	MMU	MMR	MFC	MMT
	MSC	MSS	MFR	MSI
	MMC	MMS	MFS	MMI
CONVERGENT PRODUCTION (n)	NSU	NSR	NFU	NST
	NMU	NMR	NFC	NMT
	NSC	NSS	NFR	NSI
	NMC	NMS	NFS	NMI
DIVERGENT PRODUCTION (d)			DMU	DMS
			DSU	DSS
			DSC	DMR
			DMC	DSR
EVALUATION	ESU	ESR	EFU	EST
	EMU	EMR	EFC	EMT
	ESC	ESS	EFR	ESI
	NMC	EMS	EFS	EMI

P. 2 LEFT RIGHT BRAIN CLASSIFICATION OF THE 90 SOI CELLS

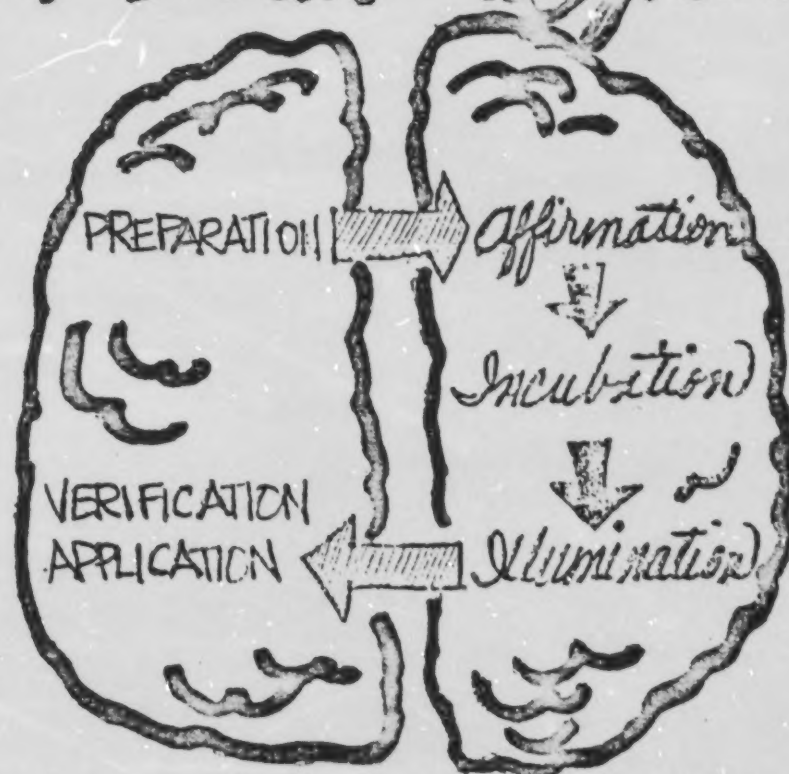
II. RIGHT BRAIN CLASSIFICATION

SOI OPERATION	PREDOMINANTLY RIGHT BRAIN ACTIVITIES	RIGHT BRAIN WITH SOME LEFT BRAIN ACTIVITIES	
COGNITION (c)		CFT CFI	
MEMORY (m)		MFT MFI	
CONVERGENT PRODUCTION (n)		NFT NFI	
DIVERGENT PRODUCTION (d)	DFT DFI	DFU DRC DFR DFS	DST DMT DSI DMI
EVALUATION (e)		EFT EFI	

THE "WHOLE BRAIN CREATIVITY PROCESS" AND BRAIN DOMINANCE

© RUBENZER, 1981

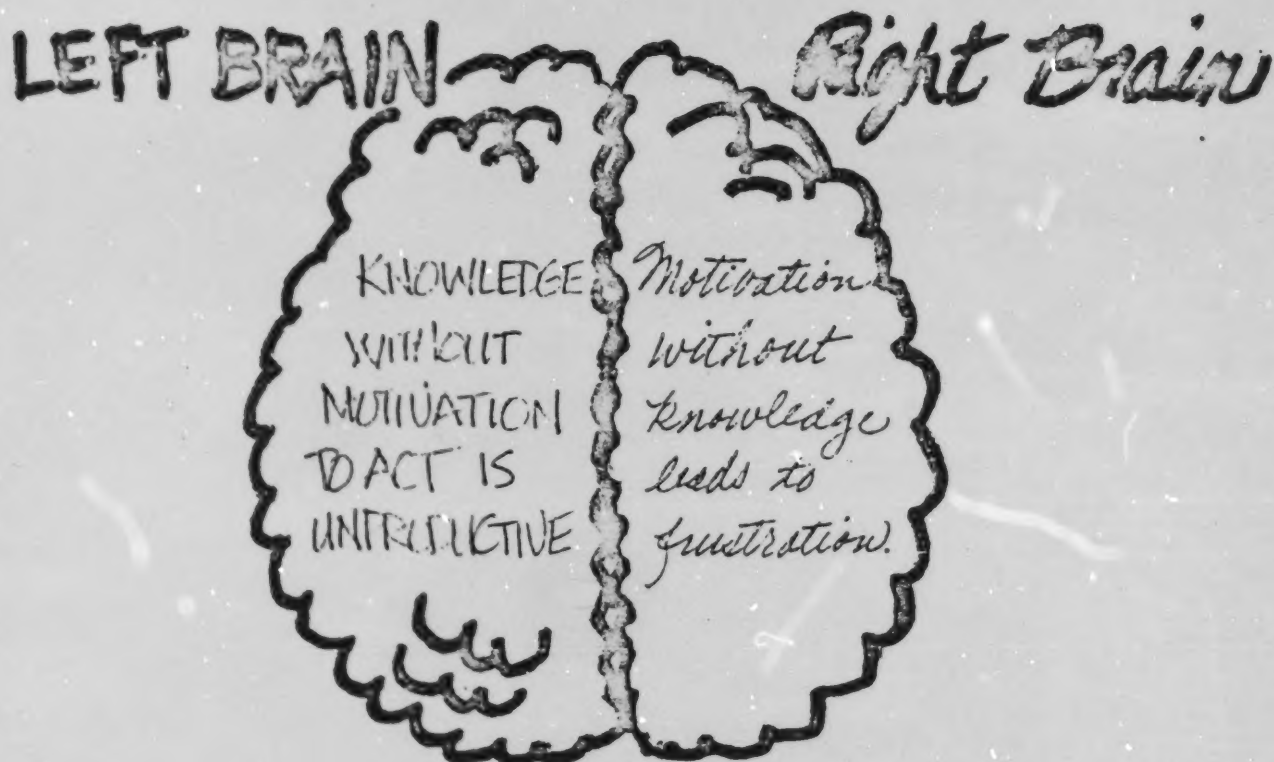
LEFT BRAIN *Right Brain*



TRUE CREATIVE GENIUS REQUIRES
THE INTERACTIVE FORCE OF BOTH BRAINS.

*SEE THE LEFT/RIGHT BRAIN CREATIVITY TAXONOMY AND THE LEFT/RIGHT BRAIN MATRIX (RUBENZER, 1981)

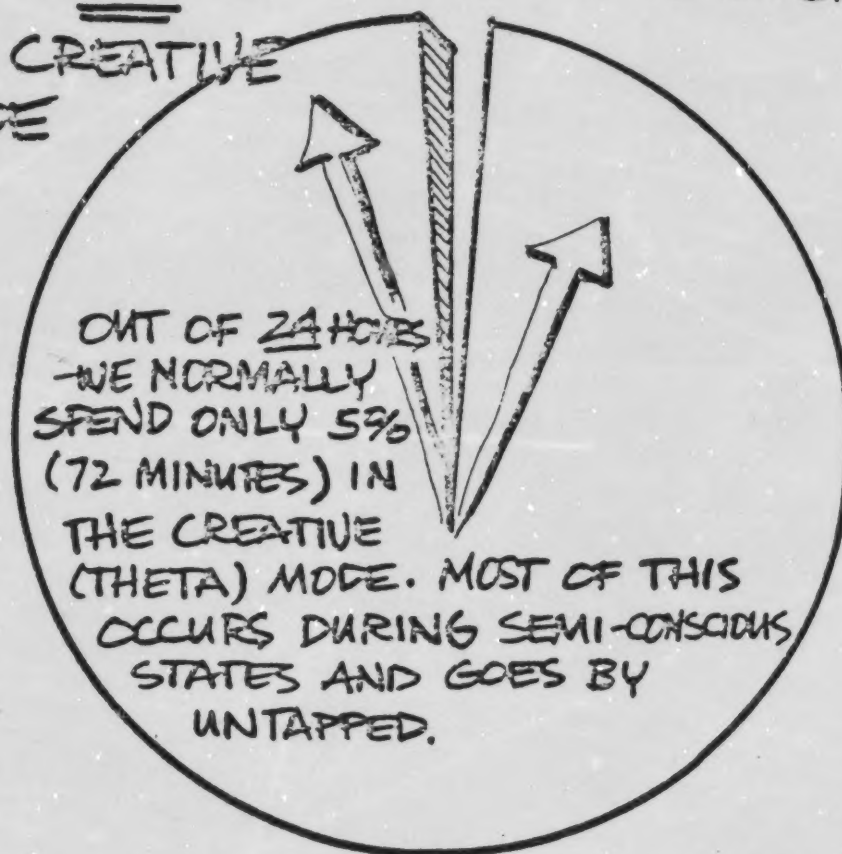
SUCCESS AND THE DUAL BRAIN



SUCCESS IN PURSUITS
REQUIRES THE FUSION
AND INTERACTION OF BOTH
LEFT BRAIN (KNOWLEDGE)
AND RIGHT BRAIN (MOTIVATION)
PROCESSES. © RUBENZER³⁰, 1981

THE NECESSITY OF CULTIVATING THE CREATIVE MODE....

ONLY 5% OF OUR TIME IS SPENT IN
THE CREATIVE
MODE



WE COULD EASILY DOUBLE OUR CREATIVE
OUTPUT BY INCREASING OUR TIME SPENT
IN THE CREATIVE (THETA) MODE THROUGH
RELAXATION TRAINING.

(RUBENZER, 1981)

PREJUDICE VERSUS THE RIGHT BRAIN

"AMERICAN SCIENTIFIC TRAINING THROUGH GRADUATE SCHOOL

MAY ENTIRELY DESTROY THE RIGHT HEMISPHERE."

(LEVY 1980)

THE RIGHT BRAIN AND CREATIVE GENIUS

UTILIZING LEFT BRAIN FUNCTIONS
ALONE WILL ONLY BRING ONE TO
THE LEVEL OF A COMPETENT
TECHNICIAN. ONLY BY TAPPING
INTO THE TREMENDOUS CREATIVE
FORCES OF THE RIGHT BRAIN
CAN AN INDIVIDUAL TRANSCEND
THE TECHNICIAN LEVEL AND ENHANCE
THE MAGIC SYNTHESIS WHICH SO
CHARACTERIZES TRUE CREATIVE
GENIUS.

(RUBENZER, 1981)

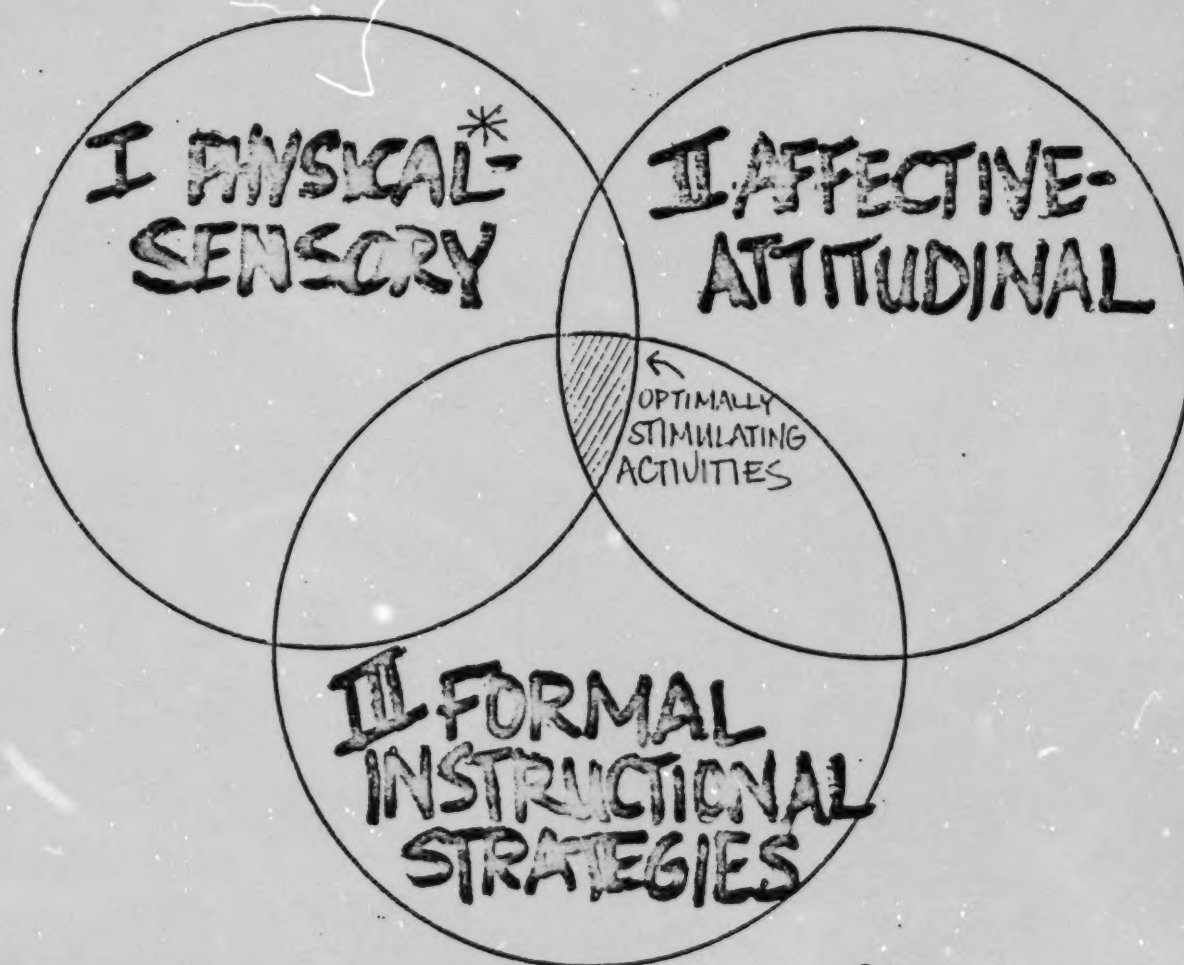
INCUBATION AND CREATIVITY

"COUNTLESS CREATIVE PERSONS IN ALL THE SCIENCES AND ARTS
HAVE RECORDED THAT MOST ANSWERS CAME TO THEM NOT WHILE
GRAPPLING DIRECTLY WITH A PROBLEM, BUT ONLY AFTER
IT HAD BEEN ALLOWED TO DROP INTO THE PIT OF THE UNCONSCIOUS
AND INCUBATE UNTIL READY TO POP OUT."

SYDNEY HARRIS IN HAROLDSEN, 1978

THE RIGHT BRAIN STIMULATION PARADIGM - © RUBENZER, 1981

"HOW TO ENHANCE RIGHT BRAIN PROCESSES"



35

*SEE WAYS TO ENHANCE RIGHT BRAIN PROCESSES.
(RUBENZER, 1981) FOR SPECIFIC ACTIVITIES

Rationale For Providing Activities Designed to Stimulate Right Brain Processes

Our educational systems up to today have almost unquestionably been devoted to the exclusive cultivation of left brain skills, such as memorization of facts, and linear thought. It goes without saying that left hemisphere skills are integral components to the creative process, however, right brain processes are of equal importance in problem-solving. It is a common experience in our school systems that right brain skills and attitudes are given a diminutive role, if any, in curricular experiences.

In the face of technological, societal and national level problems for which there are currently no apparent solutions, it is imperative that we learn to utilize all the resources at our command. William James has stated that "we use only one tenth of our mental capacity." Although the precise percentage of how much mental capacity we utilize is debatable, it is evident that we do not take full advantage of our mental resources.

Although the entire Japanese school system at the first grade level is systematically and concertedly developing right brain skills through the divergent production activities of the Structure of Intellect approach (Meeker, 1981), no such recognizable attempt to stimulate right brain processes in the United States exists today.

Computers, which were designed to take over tedious and intricate cognitive functions of the left brain, are now capable of performing these functions at a nearly infinitely more rapid and accurate manner than we can. It should be the charge of our educational systems to educate our students to manage and creatively use the tremendous information storage and processing ability of the computer to solve problems which computers are, as of yet,

not capable of dealing with. Currently we surpass computers primarily in right brain skills such as pattern recognition and the meaningful recombination of ideas and concepts. In essence, computers are of little value if we do not have creative individuals to meaningfully reconstruct mosaics of facts which will lead to solutions.

It is estimated that as little as five percent (5%) of our time is spent in a creative mode. It has been demonstrated at the Menninger Foundation at Topeka, Kansas that the time spent in the creative mode can be significantly increased through various techniques.

In order to provide an organized, multidimensional approach to the enhancement of right brain skills and attitudes, the author has constructed a three category model for the stimulation of right brain processes.

Through a review of the literature encompassing left/right brain research over the last twenty years (Rubenzer, 1979), it was found that most methods of right brain stimulation could be classified as physical sensory; affective - attitudinal - cognitive; and formal instructional (Categories I, II and III, respectively).

The rationale for the activities for each category, followed by specific descriptions and examples of each activity is provided in the remainder of this paper.

Purpose of 52 Activities to Stimulate Right Brain Processes

The purpose of the following activities is to provide readily implementable activities designed to stimulate right brain processes through three primary methods: physical-sensory; affective-attitudinal-cognitive; and formal instructional.

Each of the 52 activities is classified according to the category it falls under, (I = physical-sensory; II - affective-attitudinal-cognitive; and III - formal instructional). The title of the activity is listed, along with a description of the activity and an example of the activity if necessary. A reference is provided for each activity if available.

It is recommended that attention be provided to activities in all three categories, with heavier emphasis on activities in the physical-sensory and formal instructional categories.

Category I: PHYSICAL-SENSORY STIMULATION

Rationale For Attention to Physical-Sensory Stimulation of Right Brain Processes

Wechsler (1974) has indicated that 30% to 50% of intellectual performance is related to physiological factors such as galvanic skin response (a physiological index of anxiety). Green (1977) at the Menninger Foundation at Topeka, Kansas, has found that mental and physiological processes are inseparably associated and that performance on right brain tasks is enhanced by deep levels of physical relaxation.

Perceptual exercises, which train individuals to use their right brain processes to a greater extent predispose individuals toward using both brains in learning and problem solving.

It is estimated that 90% of all sensory input is visual. Several of the activities presented herein emphasize "looking" and "seeing" at visual information in a more "right brained" fashion (wholistic, pattern, and three dimensional emphasis). This provides more input for the creative process. Right brained methods of interpreting visual stimuli often mark the truly creative individual's mental processing. Einstein obtained his best insights through visualization, as have most of our most creative inventors scientists, and artists.

Finally, it has been demonstrated, through a large scale study by Leiter (1950) that our non-verbal - visual spatial skills level off at about a 13 year old level. The need for emphasizing right brain (visual-spatial skills) is made powerfully evident by Leiter's finding. Coordination of functions between an adult left brain, and an early adolescent right brain with respect to perceptual processing, is perhaps erratic at best, and may explain why so few individuals ever attain a high level of creativity even though their left brain skills are highly developed.

CATEGORY I PHYSICAL SENSORY STIMULATION

ACTIVITY	DESCRIPTION OF ACTIVITY	REFERENCES
Progressive Relaxation	Suggest feelings of warmth and heaviness in all muscles, particularly the forehead, jaw and shoulder muscles for 10-15 minutes	Jacobson, E. <u>Teaching and learning new methods for old arts.</u> U. S. Foundation for Progressive Relaxation, 1973.
Biofeedback	Have students raise finger temperature as measured by a small hand held thermometer through suggestions of warmth and relaxation of the hands. Only a one to two degree rise is necessary.	Brown, B. <u>Stress and the art of biofeedback.</u> New York: Harper and Row, 1977.
Autogenic Training	After students have been progressively relaxed, make suggestions of overall health, energy and relaxation.	Green, E. Autogenic training type phrases in Brown, Ibid.
Breathing Concentration Exercises	Students attend to the rhythm of their breathing patterns. Students should say subvocally "IN RELAXATION" during inhalation, and "OUT TENSION" during exhalation. (Do this five to ten minutes.)	Hendricks, G. & Wills, R. <u>The centering books: Awareness activities for children, parents and teachers.</u> Englewood Cliffs, NJ: Prentice-Hall, 1973.
Sensory Awareness Augmentation	Heighten sensitivity to sensory input by concentrating on particular stimuli while blocking out other sensations (e.g. smelling a rose while blindfolded). Describing the denominations of coins without seeing them (90% of sensory input to the brain is visual, therefore, some exercises should de-emphasize visual input to facilitate greater awareness of input from other senses.).	Henricks, Ibid
Transmodal Exercises	Crossing sensory modality experiences (e.g. what colors would certain musical tones have: how heavy, hot or cold would particular colors be, etc.).	Standish, B. <u>Sunflowering: thinking, feeling, doing activities for creative expression.</u> Carthage, Illinois 62321; Good Apple, Inc. 1977.
Dimensionalizations Activities	Translating verbal or two dimensional concepts or expressions into three dimensional objects (e.g. sculpting a heart out of clay which would capture the essence of "puppy love".).	

CATEGORY I PHYSICAL SENSORY STIMULATION (continued)

ACTIVITY	DESCRIPTION OF ACTIVITY	REFERENCES
Transfer Activities (Mirror Drawing)	Have students trace through a maze while looking only in a mirror and not at his/her hand. Do this for 5-10 minutes.	
Spatial Reorientation Activities	Students should wear mirror glasses which transpose-reverse visual images, so that up is down, down is up. Five minutes with a "normal vision" guide.	
Temporary Dominance Shift	Use opposite (non-dominant) hand, foot, etc. to perform every day functions (e.g. Write with left hand if right handed, kick a ball with right foot if left "footed").	
Weight, Weight-Distance & Temperature Estimation	Students participate in estimation exercises, which increase sensitivity to concrete stimuli (e.g. Have three wooden blocks-- all of the same size and shape but of differing density. Have the students rank order them by weight.).	
Mime	Communication of ideas through facial and bodily expression. Teaches students to simplify concepts to the most elemental components and "fine tune" bodily movements. (e.g. "mime" the concept of trust or friendship).	
Charades or Related Activities	Same as for mime	
Interpretative Dance	Same as for mime	
Illusions	By exposing students to illusions such as "Escher" prints, students become accustomed to right brain perception overriding left brain logic processes. That is, their right brain visual processes "see" something that their left brain logic cannot explain.	Beeler, N.F. & Branley, F.M. <u>Experiments in optical illusions.</u> 38 Binghamton, NY, 1951.

CATEGORY I PHYSICAL SENSORY STIMULATION (continued)

ACTIVITY	DESCRIPTION OF ACTIVITY	REFERENCES
Eidetic Imagery Training (Photographic Memory)	Have students closely observe their surroundings for one minute. With their eyes closed have them rebuild what they remember seeing either by tape recording their verbal descriptions, or by having someone else take notes. Reconstruction should be in terms of color, dimension, etc. This exercise should start off with simple descriptions and after each session should become "richer" with respect to detail. Eventually, have students recall every day scenes (routes to school) without concentrated observation first.	
Negative Space Drawing (Copying Drawings Which Are Upside Down and/or Reversed In Orientation)	Two photographs/pictures upside down. Have students reproduce what they see from this new perspective.	Edwards, B. <u>Drawing on the right side of the brain.</u> Los Angeles, CA. Tarcher, Inc., 1979.
Very Rapid Pattern Recognition (Subitizing)	This exercise called subitizing, sharpens visual pattern recognition skills for very briefly exposed stimuli (one tenth of a second or less). This activity increases sensitivity to and confidence in peripherally perceived visual stimuli, which are not always consciously perceived, but none-the-less may significantly add to the creative process. An example of this activity follows. On clear 35 mm slides, draw a series of randomly arranged dots, increasing in number from 3 to each slide to 15-20 per slide. If a tachistoscope (t scope) is available, expose each slide at a rate (perhaps one tenth of a second) which requires the student to guess at the number of dots for each slide. The slides should be presented out of numerical order. Most students will guess up to 7 dots correctly. Change rate of exposure and type of stimuli as the student improves.	

Category II. AFFECTIVE-ATTITUDINAL-COGNITIVE STIMULATION OF RIGHT BRAIN PROCESSES

Rationale For Attention to Affective-Attitudinal-Cognitive Stimulation of Right Brain Processes

One of the most compelling reasons for emphasizing development of and trust in right brain processes is that, according to Levy "American scientific training through graduate school may entirely destroy the right brain" (1980, p. 84). Right brain processes tend to be at the pre-conscious or subconscious level, are not linear in function (progress can not be measured in terms of discrete, predictable growth patterns) and are closely allied with affective functioning. This makes right brain processes very slippery in terms of measurement and our left-brain orientation toward education is therefore not predisposed to trusting these processes.

It cannot be over-emphasized however, that the most creative individuals throughout history have relied upon the subconscious processes of the right brain to bring about the "magic synthesis" of ideas which transcended all previous knowledge and catapulted us into new frontiers in the arts, science, etc.

The activities suggested below provide opportunities for cultivating and harvesting right brain products, without which the creative process can not occur.

CATEGORY II AFFECTIVE-ATTITUDINAL-COGNITIVE STIMULATION

ACTIVITY	DESCRIPTION	REFERENCES
Encouragement of Informed Intuition (i.e. facilitate incubation and illumination experiences after input of information)	The phrase "A problem does not have to be thought about in order to be solved"(Prather, 1972) captures the main idea behind the subconscious manner in which the right brain processes information. Incubation and illumination are both primarily subconscious processes during which the right brain is combining information provided to it and then sometimes forming it into a "bright idea" (illumination). In order to facilitate this process it is necessary to allow the more than 6-8 seconds of time between the teacher's questioning and students' expected responses. Allow students to "sleep on" ideas or learn to relax deeply through relaxation exercises described in Category I Activities. Also provide examples of how famous scientists obtain their greatest insights while not concentrating directly on their specific problem.	Torrance, E. P. <u>Encouraging creativity in the classroom</u> . Dubuque, IA: William C. Brown, 1970.
Insight or "Bright Idea" Retention	Insights and other products evolving from right brain processes are "slippery" with respect to retention and retrieval because they are not verbally coded and therefore not easily stored in the verbal - left hemisphere memory. Students should be encouraged to habitually keep a small notebook and pen to immediately record any pertinent insights they may have without making judgments regarding their specific merit. "Bright ideas" often occur during the twilight of our conscious experiences (i.e. during states of deep relaxation just prior to sleep or upon waking).	Haefele, J. W. <u>Creative innovation</u> . New York: Reinhold, 1962.
Utilization of the Consolidation Principle	The subconscious right brain often times repeatedly processes or reorganizes (consolidates) information we concentrate on just prior to sleep. To take advantage of the consolidation principle, it is best to simplify and repeat an idea or information seven to eight times prior to going to sleep. The information may then be reorganized into a novel format and/or stored in long term memory. Upon waking we may very well have a new combination of the information we registered just prior to sleep. This new consolidation of information could be the key to insight in solving a particular problem.	

CATEGORY II AFFECTIVE-ATTITUDINAL-COGNITIVE STIMULATION (continued)

ACTIVITY	DESCRIPTION	REFERENCES
Sustained Concentration on Non-Verbal Stimuli	To demonstrate the typical verbal left-hemisphere's dominance in daily cognitive processes, have students concentrate on non-verbal stimuli without allowing any internal verbal chatter. For example, instruct students to give one minute of undivided attention to the movement of a second hand on a watch or clock without subvocalization, internal verbal description or evaluation of the activity. This exercise involves the conscious elicitation of right brain processes and will enhance the student's ability to engage non-verbal right hemisphere processes at will.	
Positive Thinking	"The right brain is associated with negative feelings and their expression" (Gardner, 1981). The "affectively unsophisticated" right brain tends to be negative in its emotional outlook. Repetition of verbally simple, positive suggestions, prior to sleep or during states of deep relaxation (as in auto-genic training activities -- See Category I Activities) will cultivate more positive right brained emotions.	Maltz, M. <u>Psycho-cybernetics: A new way to get more living out of life.</u> Hollywood, CA. Wilshire Reference Book Co., 1967.
Visualization or Diagramming of Problems	A concise picture is worth a thousand words. Accustom students to diagramming or pictorially illustrating the basic components of an idea or problem. This simplification of the problem requires true understanding of the problem and puts it into visual terms which will facilitate right brain processing.	Buzan, T. <u>Use both sides of your brain.</u> New York: E. P. Dutton and Co., 1976.
Visualization of an End Product	At age 14 Einstein stated "I wonder what it would be like to ride on a beam of light." It has been found consistently that those individuals who can best visualize a finished product or end result, are most successful at achieving a goal or solving a problem (Haroldson, 1978). Encourage vivid visualization of end products to the fullest extent possible.	
Emotionalize	Make material to be learned as personally relevant and "emotional" as possible. The more the emotions can be involved in acquiring information, the more it will be registered in the right brain. When information is retained by both the left (orderly, verbal information) and the right brain (highly emotionally charged input) it is more likely to be remembered. A "discovery approach" to learning may facilitate the personalization of information.	Buzan, op. cit.

CATEGORY II AFFECTIVE-ATTITUDINAL-COGNITIVE STIMULATION (continued)

ACTIVITY	DESCRIPTION	REFERENCES
Analogize	Since the right brain is metaphoric and analogic in its orientation, analogic thinking will facilitate right brain processing of information. Provide students with analogy exercises such as "How is a contour map like kite flying? They both deal with elevation." (Stanish,, 1977, p. 19)	Stanish, op. cit. Harnadek, A. <u>Antonyms synonyms, similarities and differences.</u> Troy, Michigan: Midwest Publications Co., Inc., 1977.
Guided Fantasy	"Imagination is more important than knowledge" Albert Einstein. Guided fantasy experiences which can be facilitated by the student's listening to especially designed taped, facilitates the right brain imaginative visualization processes. As indicated previously, visualization appears to be an important component in problem solving. Students should be encouraged to compose their own fantasies as lavishly as possible. This primes the imaginative properties of the right brain for use in problem solving.	Good Apple. <u>Flights of Fantasy</u> , Box 299, Carthage, IL. 62321, 1980.
Non-Verbal Illustrations of Concepts, Ideas, etc.	Students should draw out (on large sheets of paper) their most important goals or concerns (e.g. Students may create their own logos with no accompanying caption which best describes What they believe in, or want to achieve.	
Musical Rhythmic Expression	It is a common experience that information that is presented in a rhythmic and/or musical fashion is retained to a much greater degree than only verbally coded information (advertising invest heavily into pairing verbal and musical messages that "stick"). Rhythm and music are both "fortes" of the right brain and should be brought into play whenever possible. Have students develop jingles which convey an important message or seell a real or imagined product.	

ACTIVITY

DESCRIPTION

REFERENCES

Poetic
Expression

Both the verbal processes of the left brain and emotional qualities of the right brain are brought into play through poetry. Expose students to good, relevant (age appropriate) poetry and provide opportunities for students to be poetically expressive.

Humor

Humor draws on both left (verbal) and right (emotional) brain processes. Have students read, cut out and bring in humorous material. Simple humorous, word puzzles are also most effective in enhancing integrated (left and right brain) processing. Encourage the student's creation of humorous cartoons, clever sayings, etc.

Mulac, M. Perceptual games and activities. New York: Harper and Row, 1977.

"Sunflower-
ing"
(Creativity
Exercises)

Approximately fifty highly imaginative, yet practical classroom activities are included under "sunflowering" strategies which rely heavily on the use of analogies, visualization, non-evaluation of responses and open endedness.

Stanish, op. cit.

Eberle's
SCAMPER
Techniques

Ten strategies, listed below and expressed in the acronym SCAMPER reflect good strategies for enhancing right brain processing.

Eberle, B. Scamper: Games for Imagination Development. DOK Publishers, Buffalo, NY, 1971.

- Substitute To have a person or thing act or serve in the place of another
- Combine To bring together, to unite.
- Adapt To adjust for the purpose of suiting a condition or purpose.
- Modify To alter, to change the form or quality.
- Magnify To enlarge, to make greater in form or quality.
- Minify To make smaller, lighter, slower, less frequent.
- P Put to To be used for purposes other than originally intended.
- E Eliminate To remove, omit, or get rid of a quality, part, or whole
- R Reverse To place opposite or contrary to, to turn it around.
- Rearrange To change order or adjust, different plan, layout or scene

CATEGORY II AFFECTIVE-ATTITUDINAL-COGNITIVE STIMULATION (continued)

ACTIVITY	DESCRIPTION	REFERENCES
Origami (Paper Folding)	These activities rely heavily upon visual-spatial abilities of the right brain and also improve visual-motor coordination.	Davidson, G. <u>Origami</u> . New York: Larousse, 1975. Benjamin, R. <u>Origami for everyone: paper folding step by step in photographs and games</u> . Blaauvelt, NY: Biograf Books, 1973.

Category III: FORMAL INSTRUCTIONAL STIMULATION OF RIGHT BRAIN PROCESSES

Rationale for Attention to Formal Instructional Stimulation of Right Brain Processes

To provide a systematic, planned approach to enhancing creative, right brained processing of information, it is necessary that well organized, implementable approaches be used in the classroom. The following activities and references represent field tested, successful curricula which are designed to enhance the creative process.

CATEGORY III ACTIVITIES (NORMAL INSTRUCTIONAL)

ACTIVITY	DESCRIPTION OF ACTIVITY	REFERENCES
Art Activities	Over 15 readily implementable units in art, specifically designed to stimulate right brain processes, are provided. (Grade three and up) Reproducible student activity sheets are included in this curriculum guide.	O'Dell, D., Kerr, P. and Rubenzer, R. <u>Artistic expression through right brain activities</u> , 2916 La Veta, NE Albuquerque, NM 87110, 1981.
General Creativity Activities	This is a compilation of 109 teacher made activities which are classified under 15 creative processes. Many of these processes are directly related to right brain stimulation (centering, sensory awareness, brainstorming, creative dramatics).	Jensen, L. <u>Creativity activities from: the duality of the brain project</u> . College of Education, 445 Ritter Hall, Temple University, Philadelphia, PA 13122, 1981.
Activities Emphasizing All Generally Recognized Levels of Cognitive Functioning (Cognition, Memory, Convergent Thinking, Divergent Production and Evaluation)	90 of the most popularly utilized Structure Of Intellect (SOI-Meeker, 1969) activity descriptors are classified according to left/right or integrated brain functioning. This hemispheric classification of SOI descriptors provides left/right brain keyed access to thousands of field tested, readily implementable activities, so that a more integrated (left and right brain) curriculum can be developed. Useful for developing Individualized Educational Programs (IEP's) also.	Rubenzer, R. <u>Implementing a left and right brain curriculum through the Structure of Intellect Approach: Implications for "whole" child gifted education</u> . Department of Special Education, College of Education, University of New Mexico 87131, 1981. Meeker, M. <u>SOI Workbooks</u> . 343 Richmond Street, El Segundo, CA 90245, 1981.
Mathematics	Curricular activities related to enhancing integrated brain functioning.	Elliott, Portia C. <u>Going "back to basics" in Mathematics won't prove who's "right," but who's "left" (Brain duality and mathematics learning)</u> . Intern'l Jnl of Mathematical Educ in Sc & Tech, Apr 80.
Science (Elementary)	Elementary science teaching methods for enhancing right brain processes.	McCormack, Alan J. <u>Lemons, mealworms, and the giant amoeba: a eureka trip through school science</u> . National Elementary Principal, v 59, n 2, p 54-60, Jan, 1980.

CATEGORY III ACTIVITIES RMAL INSTRUCTIONAL)

ACTIVITY	DESCRIPTION OF ACTIVITY	REFERENCES
Art	General suggestions and defenses for art as related to cultivating right brain functioning.	Samples, Robert E. <u>New perspectives--on art education.</u> Thrust for Educational Leadership, 1978.
General Teaching Strategies (Middle School)	Emphasize that brains fo 12-14 year olds are in a slow growth period, and therefore should concentrate on the <u>enrichment</u> of already acquired cognitive skills.	Epstein, H.T., Toppfer, C.F. <u>A neuroscience basis for reorganizing middle grades education.</u> Educational Leadership, 1978.
Centering Exercises, Art and Imaging	Defenses and techniques for using art and centering (relaxation techniques) for facilitating more integrated (left and right brain) cognitive functioning.	Kent, R. B. <u>Viewpoint--centering as a process for children's imaging.</u> School Arts, 1977.
Creativity Exercises	General methods for increasing creativity through concentration exercises are presented.	Weiss, Sydell. <u>Creating creativity.</u> Curriculum Review, 1977.
Concentration Activities		
General Instructional Strategies	Practical suggestions are provided for stimulating both left and right brain processing of information in the classroom.	Samples, Robert. <u>Neurophysiology and a new look at curriculum.</u> Thrust for Education Leadership, 1976.
English Curriculum As Related To Moral Reasoning	An outline is presented for English lessons which pivot about several relevant left/right brain theories and Kohlberg's moral development paradigm.	Milner, J. O. <u>Moral felicity, hemispheresity, cultur complicity.</u> Paper, March 16-18, 1978 at the Annual Meeting of the Conference on English Education (16th, Minneapolis, MN.
Photography	Right brain processing of information through photographic activities in the classroom is encouraged through the curricular suggestions forwarded in this paper.	Routh, R. D. <u>Photography as therapy.</u> Paper, May 11-14, 1977 at the Annual Meeting of the International Visual Literacy Assoc. (9th, Iowa City, IA).

CATEGORY III ACTIVITIES M/L INSTRUCTIONAL)

ACTIVITY	DESCRIPTION OF ACTIVITY	REFERENCES
Perceptual Training Activities	A multiplicity of curricular suggestions for augmenting sensory-motor perception (primarily right brain skills) is offered in this article. (Emphasis is placed on learning handicapped children.)	<u>Sensory-motor perception. Preliminary findings of a cooperative curriculum project. Report # DPSC-66-1268</u>
Writing Curriculum	Implications of left/right brain research for the improvement of writing skills are presented.	<u>Hoyle, S. G. Research, rhetoric and the writing curriculum: consciousness expansion through bi-hemisphericity. Dissertation from Drake University, 1980.</u>
Computer Programming	Recommendations for the use of computers to develop both left and right brain processes are forwarded in this work.	<u>Coppus, S. A. An investigation into computer programming as an academic discipline which provides education for both sides of the brain. Dissertation from University of Massachusetts, 1978.</u>
Cognitive (Left Brain) Affective (Right Brain) Curricular Activities	Numerous and specific strategies for stimulating both cognitive (left brain) and affective (right brain) functioning in the classroom are presented.	<u>Williams, F. E. Models for encouraging creativity in the classroom by integrating cognitive-affective behaviors. Educational Technology, 1969.</u>

THE BILINGUAL BRAIN

"KNOWLEDGE OF MULTIPLE LANGUAGES
HAS ANATOMICAL CONSEQUENCES."

OBLERT ALBERT 1976

TWO LANGUAGES SHARE SAME BRAIN SPACE, BUT EACH ALSO
HAS AREAS OF ITS OWN.

THE SECOND LANGUAGE APPEARS TO OCCUPY MORE CORTEX THAN
THE FIRST.

OJEMANN AND WHITAKER
1981

NEUROMETRICS

THE ELECTRONIC MONITORING AND RECORDING OF THOSE NEUROLOGICAL
PROCESSES WHICH ARE ASSOCIATED WITH SPECIFIC COVERT AND OVERT
MENTAL OPERATIONS.

(Rubenzer, 1981)

THE APPLICATION OF NEUROMETRICS: PETT III AT BROOKLYN LABORATORY

THIS TECHNIQUE USES A "RADIOACTIVELY TAGGED" GLUCOSE SOLUTION WHICH IS LITERALLY "FOOD FOR THOUGHT" (I.E. WHEN BRAIN CELLS ARE ACTIVELY INVOLVED IN PROCESSING, THEY CONSUME GLUCOSE AS "FUEL"). DURING A PARTICULAR MENTAL ACTIVITY THE PARTS OF THE BRAIN WHICH ARE DIRECTLY INVOLVED WITH THE ACTIVITY "DEVOUR" MORE OF THE RADIOACTIVELY-TAGGED GLUCOSE. THIS DIFFERENTIAL CONSUMPTION RATE BY THE MORE ACTIVE BRAIN CELLS IS THEN TRACED AND RECORDED DURING SPECIFIC MENTAL ACTIVITIES.

THE RESULT OF THIS TRACING IS AN IMMEDIATE ELECTRONIC "MIRROR IMAGE" OF PRECISELY WHAT PARTS OF THE BRAIN ARE BEING CALLED UPON DURING THE SPECIFIC MENTAL PROCESSES.

THROUGH THIS PROCEDURE, DIRECT CAUSAL RELATIONSHIPS BETWEEN THE STRUCTURAL AND FUNCTIONAL ASPECTS OF THE BRAIN CAN BE ESTABLISHED. THE PREVIOUSLY INACCESSIBLE UNDERLYING NEUROLOGICAL PROCESSES WHICH ARE ASSOCIATED WITH THE ENTIRE SPECTRUM OF MENTAL FUNCTIONING CAN NOW BE STUDIED (AND PERHAPS IMPROVED UPON) TO AN UNPRECEDENTED DEGREE.

SOME OF THE CURRENT APPLICATIONS OF NEUROMETRIC TECHNIQUES—
SUCH AS PETT III, INVOLVE ESTABLISHING THE NEUROLOGICAL CORRELATES OF:

- 1) THE CREATIVE PROCESS
- 2) LEARNING DISABILITIES
- 3) BEHAVIORAL DISORDERS

PAGE 2 - THE APPLICATION OF NEUROMETRICS; PETT III AT BROOKLYN LAB.

APPROXIMATELY 50 TO 60 MILLION DOLLARS ARE BEING SPENT THIS YEAR ON NEUROMETRICS, AND OVER 500 SCIENTISTS PER YEAR ARE JOINING THE FIELD OF LEFT/RIGHT BRAIN RESEARCH.

THE MOST IMMEDIATE APPLICATION OF NEUROMETRIC RESEARCH RELATES TO THE NEED FOR DIFFERING INSTRUCTIONAL STRATEGIES ACCORDING TO THE FIXED PHYSIOLOGICAL CHARACTERISTICS OF THE INDIVIDUAL.

IT HAS BEEN FOUND THAT THE SUBJECT'S SEX, EYE AND HAND DOMINANCE, AND AGE ALL INTERACT TO IMPORTANTLY INFLUENCE HOW INFORMATION IS PROCESSED. NEUROMETRIC RESEARCH STRONGLY SUGGESTS THE NEED FOR TRULY INDIVIDUALIZED EDUCATION WITH PARTICULAR ATTENTION TO THESE CHARACTERISTICS OF THE STUDENT.

(Rubenzer, 1981)

THE BRAIN AND LEARNING DISABILITIES

PART OF MOST PEOPLE'S BRAINS IS LARGER ON THE LEFT SIDE THAN THE RIGHT. (THE PARIETAL AND OCCIPITAL LOBES -- SECTIONS INVOLVED IN READING, WRITING, MATH SKILLS AND SIGHT). OUT OF 53 LEARNING DISABLED STUDENTS, (READING TWO YEARS BELOW GRADE LEVEL), 42% HAD PARIETAL AND OCCIPITAL LOBES WHICH WERE WIDER ON THE RIGHT. THIS REVERSED ASYMMETRY (RIGHT BEING LARGER THAN LEFT) USUALLY OCCURS IN ONLY 25% OF THE GENERAL POPULATION.

(ROSENBERGER, DIRECTOR OF LEARNING DISORDERS UNIT AT MASS. GENERAL HOSPITAL, 1980)

EDUCATIONAL IMPLICATIONS OF HEMISPHERIC RESEARCH

1. SHIFT OF EMPHASIS FROM IMPROVING CURRICULA TO INCREASING THE STUDENT'S RECEPTIVITY (META-SKILLS) TO LEARNING EXPERIENCES & MATERIALS.
2. A MORE BALANCED (INTEGRATED) APPROACH TO TEACHING. TEACH TOWARD BOTH LH & RH.
3. FOCUS MORE ON PROBLEM FINDING (RH) THAN ONLY PROBLEM SOLVING (LH) BY INCREASING THE STUDENT'S SENSITIVITY.

4. IMPROVEMENT OF INTELLECTUAL AND CREATIVE PRODUCTION THROUGH GREATER KNOWLEDGE OF PSYCHOPHYSIOLOGICAL CORRELATES OF HIGHLY CREATIVE AND INTELLECTUAL STATES. IF THESE PSYCHOPHYSIOLOGICAL STATES CAN BE ELICITED CONSISTEDLY, THE PROBABILITY OF THE INVENTIVE MODE OCCURRING MAY BE INCREASED.

CREATIVITY WILL BE PRACTICED MORE SYSTEMATICALLY, THEREFORE MORE OF MANKIND'S FULL POTENTIAL WILL BE REALIZED.

SCORING KEYS

Form A

line	A	B	C	line	A	B	C
1	L	R	I	19	R	I	L
2	L	R	I	20	R	I	L
3	R	I	L	21	R	R	I
4	R	L	I	22	R	L	I
5	L	R	I	23	L	R	I
6	L	R	I	24	L	R	I
7	R	L	I	25	L	R	I
8	R	L	I	26	R	L	I
9	R	L	I	27	R	L	I
10	L	R	I	28	L	R	I
11	R	L	I	29	L	R	I
12	L	R	I	30	L	R	I
13	R	I	L	31	L	R	I
14	L	R	I	32	L	R	I
15	R	I	L	33	L	R	I
16	R	L	I	34	L	R	I
17	R	L	I	35	R	L	I
18	R	I	L	36	L	R	I

Where L = left, R = right and I = integrated or balanced

LEARN PROVEN METHODS TO MORE FULLY USE
THE OTHER 90% OF YOUR BRAIN POWER IN
LEARNING, MOTIVATION AND CREATIVITY!!

PURPOSE OF WORKSHOP

The Brain Workshop will provide useful, relevant information on how the brain functions. This Nobel Prize winning topic will become increasingly more crucial to understanding and maximizing learning and creativity in the future.

No formal background on brain research is needed.

WORKSHOP TOPICS

- History of the Brain.
- How brain functions and learning styles are measured.
- The "division of labor" between the left and right brain.
- The effects of education, sex, handedness, age, anxiety, diet, and bilingualism on brain functions.
- Learning disabilities.
- Creative genius and brain functions.
- Diagnosis and improvement of mental health states.
- Practical suggestions on how to use more of your brain's capacity.

WORKSHOP BENEFITS

Methods of stimulating right brain processes or how to stay in your RIGHT MIND.

Specific methods for enhancing right brain creative processes will be demonstrated through biofeedback relaxation techniques, guided fantasy, perceptual exercises, and determining and shifting learning styles.

Participants will be given the opportunity to use clinical biofeedback equipment.

Conference coordinator for Temple University, Dr. Linda Jensen, wrote:

"Excellent workshop. Your research in the area of brain functioning is outstanding and is very useful to teachers of all types of students. Teachers reported gaining many new insights into brain functioning, as well as receiving practical ideas for teaching the "whole child". I enjoyed it immensely myself, and look forward to attending another one."

Dr. Joseph Renzulli, an internationally recognized expert in gifted education, and professor of educational psychology at the University of Connecticut, has stated:

"This was one of the most informative and well-received workshops that has been presented to our graduate students and I certainly appreciated both the sophistication of your material and the superb manner in which it was conveyed to the group."

WORKSHOP MATERIALS

Brain Owner's Manual:

Each participant will receive a 75 page research based primer on left/right brain functions containing over 60 practical educational activities to stimulate integrated brain processing. It features over 200 references, including the results of a current national computer search for left/right brain curricula.

A potpourri of materials designed to enhance whole brain functioning will be available for perusal.

A prepublication preview of a field tested curriculum, *Artistic Expression through Right Brain Activities*, will be featured.

WORKSHOP PRESENTER

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THE ROLE OF THE RIGHT HEMISPHERE IN LEARNING & CREATIVITY: IMPLICATIONS FOR ENHANCING PROBLEM SOLVING ABILITY

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ABSTRACT

By generating empirically testable physiological models of cognition and affect, the understanding and facilitation of learning and problem solving can be advanced. A review of the representative research and theoretical literature on right hemisphere processes and psychophysiological models regarding the functional organization of the brain is presented. The major roles of the right hemisphere processing modes in language, learning, perception, creativity and affect are discussed. A psychophysiological model of problem solving is proposed.

The necessity for attempting to more fully understand, and thus perhaps more directly enhance learning and creativity has been considered by Guilford (1975) to be central to education, as indicated when he stated, "I have advocated, and I still do, that the student be taught about the nature of his own intellectual resources, so that he may gain more control over them" (p. 120).

A technique for investigating the nature of these "intellectual resources" which appears to circumvent some of the conventional biasing factors (subject fatigue, socioeconomic background, attitude, test reliability and validity (Anastasi, 1971) involved in paper and pencil testing through which most hypothetical models of intellectual functioning have been constructed, is the psychophysiological approach (psychophysiology is "the study of physiology in relation to the mind and its processes." Hinsie & Campbell, 1960, p. 610.) The psychophysiological approach to the analysis of mental functioning is gaining great impetus (Brandwein & Ornstein, 1977; Brown, 1977; Gowan, 1975; Green et al., 1969; Mulholland, 1971; Ornstein, 1978; Samples, 1975; Schwartz, 1976). Davidson and Krippner (1971) have coined the expression "the science of subjective experience" for the psychophysiological method of research. In describing this "science of subjective experience" they state:

Through the use of converging operations (recur specific physiological patterns) we can obtain objective evidence for the existence of hypothetically constructed psychological states. That is, if we ask a subject what is going through his mind and we simultaneously obtain a variety of physiological measures, we can determine whether a specific physiological indicator correlates with the subject's verbal report...Through the combined use of verbal reports and physiological measures, "subjective" states of consciousness can be studied with a scientific precision that was, until recently, unavailable. (p. 30)

One of the major psychophysiological approaches involves correlating the degree of left or right hemisphere involvement with reported cognitive and affective states.

This review of the empirical and theoretical literature regarding the cognitive and affective functions of the right hemisphere is a synthesis and interpretation of representative hemisphericity research (the study of the functional organization of the brain according to the left or right hemisphere) within the last 15 years. The hemisphericity research reviewed included medically intrusive (commissurotomy--Gazzaniga, 1967; Sperry, 1974, lobotomy -- Maksymczuk, 1973; hemispherectomy--Burklund & Smith, 1977; electroconvulsive therapy--Fromholt et al., 1973; and sodium amytal--Branch et al., 1964), medically non-intrusive (electroencephalography--Newton, 1975; lesion diagnosis--Luria, 1970) and non-medical non-intrusive (dichotic listening tasks--Kimura, 1967; visual field--Day, 1964; Olson, 1977; saccadic eye movement--Harnad, 1972; and laterality--Williams, 1976) studies. The studies reviewed included approximately 1,600 subjects and only those studies specifying the subject variables of age, handedness and sex were reviewed. Unless otherwise noted, the subjects were right-handed adults. (See reference note)

The Anatomical and Functional Characteristics of the Right Hemisphere

The right hemisphere, sometimes referred to as the minor or non-

1 Medically intrusive research denotes direct alteration of the structure or function of the brain, whereas medical non-intrusive studies involve the measurement of the brain functions without neural tissue or function interference.

dominant hemisphere because of its lesser role in verbal functioning (Durvai & Smyk, 1972) was found by Geschwind (1970) in a neonatal study to be anatomically smaller than the dominant or left hemisphere.

Verbal processing. As more research on hemisphericity is being conducted, it is becoming evident that the right hemisphere is not totally silent. In fact, it has been discovered that the language function is somewhat more equally shared between the left and right hemispheres before the age of five (Lenneberg, 1967) and for left-handed (Goodglass & Quadfasel, 1954) and ambidextrous adults (Kupfermann, 1977). Furthermore, the results of studies demonstrate that the right hemisphere is capable of processing language if the discriminations are uncomplicated (e.g., a positive from a negative statement) (Butler & Glass, 1974) and sufficient time is allowed (Hogen & Gazzaniga, 1965; Gazzaniga & Hillyard, 1971; Nebes & Sperry, 1971; Weisenberg & McBride, 1935). It was found by Moscovitch, Scullion, and Christie in 1976, that the sufficient time for right hemispheric processing of "uncomplicated" verbal discriminations was 100 msec, or double the amount of time required for the left hemisphere to process the same information.

The analysis of voice intonation, an integral component of language, appears to be a function of the right hemisphere (Van Lanker, 1975). The primary verbal expressive mode of the right hemisphere is speculated to be metaphorical in nature (poetry, analogies) (Eccles, 1973; Ornstein, 1972; Samples, 1975); however, in general the verbally communicative ability of the right hemisphere is relatively limited.

Visual processing. The interpretation of complex visual patterns has been found by several researchers to be a predominantly right hemisphere function (Compton & Bradshaw, 1975; Goyvaerts, 1975; Moscovitch, Scullion & Christie, 1976; Schwartz, Davidson & Puzash, 1976). Further, the right hemisphere is much more adroit in the recognition and retention of facial features (Hecaen, 1973; Hillard, 1973; Muller, 1973), while the left hemisphere remembers the names that go with the faces. The retention of visual patterns, such as geometric designs and graphs is believed to also be in the dominion of the right hemisphere (Hines, et al., 1976; Smith, 1972; Veg. & Parsons, 1969). It is also contended that the iconic presentation of information (e.g., graphic displays, diagrams, flow charts, etc.) greatly facilitates both the comprehension and retention

of information, and that this iconic memory is primarily a function of the right hemisphere (Taylor, 1978). Visuo-spatial perception and reasoning, which are posited to be right hemispheric operations (Benton, 1969; Hunter, 1976; Kinsbourne & Smith, 1974; Knox & Kimura, 1970; Milner, 1971; Warrington & Milner, 1971), are the processing skills that are required in such tasks as architecture and sculpture.

Auditory processing. For most individuals, the perception and retention of complex nonverbal auditory patterns, such as music or morse code occur in the right hemisphere (Bulfer, 1976; Dumas & Morgan, 1975; Entus, 1975; Faglioni, Springer & Vigorelo, 1969; Kimura, 1973; Mollesse, 1975; Olson, 1977; Schwartz, Davidson & Pugh, 1976). It should be noted, however, that Bever and Chiarello (1974) reported that experienced musicians analyze musical patterns via the left hemispheric processing mode, similar to the manner in which most individuals analyze speech patterns.

Proprioceptive processing. Awareness of body position, spatial orientation, and the perception of fine and gross motor activities all come within the realm of the right hemisphere (Brandwein & Ornstein, 1977; Delenzy & Nichelli, 1975). This kind of bodily awareness is the *sine qua non* of ballet and other types of dance, gymnastics, and most activities requiring synchronized bodily movements. Haptic or tactile perception is contended by Kimura (1973) to be a right hemispheric function, based on the observation that there is a pronounced preference for the left hand to be used in the reading of braille. This inference is based upon the principle of contralaterality of hemispheric processing. That is, when stimuli are received in the left visual, auditory or sensory field, it is assumed that these stimuli will be processed in the right (opposite) hemisphere (Lawson, 1975; Kimura, 1967; Williams, 1976.)

The Right Hemisphere in Education

The subjects that are speculated to be processed by the right hemisphere are art, music, and physical education (Samples, 1975). Geometry, which is primarily iconic (graphic) in its format has also been attributed to right hemispheric processing (Hunter, 1976).

Cognitive Styles of the Right Hemisphere

The cognitive styles which are considered characteristic of right hemispheric processing are those skills which are indispensable for generating solutions to problems for which there are no apparent

answers. The predominant cognitive styles of the right hemisphere have been described as creative (Hogen & Gazzaniga, 1965; Harnad, 1972; Tart, 1972; Torrance, 1978) and divergent (Kinsbourne & Smith, 1974; Peronne & Pulvino, 1977; Samples, 1975; and Williams, 1976). Another characteristic of the right hemisphere is the capacity to simultaneously (but not sequentially) process several variables, or to deal with information analogically (Salk, 1973). The ability to obtain a global view or a "gestalt" of a situation or task also appears to be a primarily right hemisphere capacity (Diamond & Beaumont, 1974; Papcun, 1974). Intuitive reasoning has been attributed to the right hemisphere as well (Garrett, 1976; Rennels, 1976).

The right hemisphere, perhaps because of its capacity to process multiple stimuli simultaneously, has been described as being satisfied with "approximate knowledge" (Prince 1976), and is more diffuse and less clearly demarcated in its cognitive style than the left hemisphere (Semmes, Weinstein, Ghent & Teuber, 1960). The "Education of Relations" (May, 1977) or the ability to analogically perceive relationships among apparently unrelated concepts or stimuli (which could be considered to be tantamount to generalization ability) also appears to rely predominantly upon the right hemisphere processing mode.

Affective Concomitants of the Right Hemisphere

It is contended (Schwartz, 1975) that the right hemisphere plays a predominant role in the affective domain. Research indicates that the right hemisphere is generally involved in aesthetic judgment tasks, and when the stimuli being processed are perceived as aesthetically harmonious, the accompanying affective state is pleasurable and positive. Negative emotions are believed to be associated with the right hemisphere's processing of stimuli which are perceived as discordant or cacophonous (Hadarnard, 1945; Hebb, 1966).

Current Research Regarding the Physiological Correlates of Cognitive and Affective Functioning

The method of ascertaining the degree of hemispheric involvement in cognitive and affective tasks which is currently receiving unprecedented attention is electroencephalogram (EEG) pattern analysis (Brown, 1977; Green, Green & Walters, 1970; Ornstein, 1978). Basically, the EEG is the graphic record of the regular, spontaneous oscillations of the electrical activity of the brain (Hinsie

& Campbell, 1960, p. 259). It has been asserted that EEG pattern analysis is the most accurate measure of neurological concomitants of mental activity because it is the total resultant of bioelectrical activity of the neurons (Darwai & Smyk, 1972). Furthermore, in the EEG pattern analysis of cognitive and affective functioning there is no alteration of neural tissue (as in commissurotomy, hemispherectomy and lobectomy research) or cognitive or affective states (as in electroconvulsive or sodium amytal studies). The principle concerns in EEG research are the correct placement of the electrodes on the subject's scalp and the accurate interpretation of the EEG.

The cognitive and affective functioning paradigms currently being developed as the result of EEG pattern analysis research appear to be accurately predictive, i.e., the cognitive affective states of subjects can be predicted at a much greater than chance level based solely on EEG pattern analysis (Brown, 1977; Green, Green & Walters, 1970; Kamiya, 1967, 1969; Luria, 1970; Ornstein, 1978).

Varying modes of cognitive and affective functioning appear to have characteristic and concomitant EEG patterns which can be divided into four basic frequency ranges (the frequency of the electrical activity of the brain is measured in cycles per second or hertz (Hz), delta, theta, alpha and beta. The reported cognitive and affective states which have been found to be associated with each of the four EEG frequency ranges are as follows:

Delta. The delta EEG wave pattern is characterized by regular slow frequency waves ranging from .5 to 3.0 cycles per second (Hz.) (Brown, 1977; Green, Green & Walters, 1970). The delta EEG pattern is recorded most often during the deeper stages of sleep, and is associated with the dream state (Brown, 1977; Green, Green & Walters, 1970).

Theta. The theta EEG wave pattern has a relatively faster frequency than the delta EEG pattern, generally occurring within the 3.5 to 7.5 Hz. frequency range. Theta is most often recorded during the semi-sleep state; that is, between dreaming and waking. It has been found that most individuals are in this theta state about 6% of the time (Green, Green & Walters, 1970). Evidence indicates that it is during this state between dreaming and waking, which is consistently characterized by the theta wave pattern, that insights or shifts in perspective (Budzynski, Stoyva & Adler, 1970; Brown,

1977; Gowan, 1974; Green, Green & Walters, 1979; McKellar & Simpson, 1954; Norman, 1977; Sittenfeld, 1972) and states of reverie occur (Green, Green and Walters, 1970). These "insight-reverie" states are considered to be essential components of creativity (Davidson & Krippner, 1971; Foulkes & Vogel, 1965; Lutho & Geissmann, 1963). Several studies of creative genius indicate that highly creative individuals experienced their most creative insights during states of dreamlike "reverie" whereby reality testing was temporarily suspended (Ghiselin, 1952; Gowan, 1972; Green, Green, & Walters, 1970). Green, Green and Walters (1970) have stated that "there are hundreds of anecdotes which show beyond doubt, that in some way, although not perfectly understood, reverie and creativity are associated" (p. 18). As previously indicated, it is estimated that only 5% of our time is spent in this "reverie state", as measured by the EEG record. Walkup (1965) has suggested that those individuals who have been considered truly creative, are those individuals who have learned how to consciously bring about these reverie or insight states. This insight-reverie mode has characteristics which reflect right hemisphere processing (Brandwein & Ornstein, 1977, May, 1977; Torrance, 1978).

Alpha. The alpha wave pattern is typified by EEG frequencies in the 8 to 13 Hz. range (Brown, 1977; Green, Green & Walters, 1970; Hinsie & Campbell, 1960). The cognitive styles which are associated with this alpha state have been described as receptive (Brown, 1977), problem finding (Deikman, 1971; Murphy, 1958), and involve narrowing of the perceptual field (Honorton, Davidson & Bindler, 1972; Lynch & Paskewitz, 1971). Illumination, insight or reverie experiences are also reported to occur during this state (Budzynski, 1971; Gowan, 1972; Green, Green & Walters, 1969, 1970; Kamiya, 1969; McKellar & Simpson, 1954; Norman, 1977). A state of "relaxed wakefulness" (Brown, 1977; Lindsley, 1960; Nowlis & Kamiya, 1970) is usually expressed by individuals who are in this state, as are feelings of psychological integration or physiological unity (Hellas & Gaier, 1970; Paskewitz, Lynch, Orne & Castello, 1970; Schwartz, 1976). This state of relaxed wakefulness appears to involve functions of both the right and left hemisphere, although the right hemisphere processes may be predominant.

Beta. The beta EEG pattern, which ranges from approximately 13.5 to 40 Hz. in frequency is generally accompanied by reports of externally focused attention (Deikman, 1971; Salamon & Post, 1965), and this increased external focus is evidenced by findings that

reaction time to external stimuli is fastest in the α state (Woodruff, 1975). This beta state has also been interpreted as being typified by increased problem-solving ability (Sheer, 1975). Deikman (1971) has stated that psychological manifestations of the beta state are "object based logic, heightened boundary perception, and dominance of formal characteristics over the sensory; (i.e., shapes and meanings have a preference over colors and textures)" (p. 59). These characteristics of the beta state are suggestive of what Deikman (1971) has coined the "action mode", which is evidenced by externally focused attention and goal orientation. The descriptions of the beta state correspond to left hemisphere functions almost exclusively (Gruzelier & Hammond, 1976; Kraft, 1976; Lawson, 1975; Maksymczuk, 1973).

An analysis of the EEG literature indicates that as the frequency range of the EEG pattern decreases from 40 Hz. to .5 Hz., cognitive and affective states acquire characteristics which are increasingly more descriptive of right hemisphere functioning. The degree of right hemisphere involvement also seems to be positively related to levels of relaxation as manifested by decreased muscle tension or other physiological parameters of relaxation.

The Elicitation of Various Cognitive and Affective States

Recent findings in psychophysiological research suggest that not only can relationships between mental functioning and physiological states be established (as reflected by EEG patterns), but that these physiological states which are associated with certain types of cognitive-affective states can be consciously elicited (Green, Green & Walters, 1970; Kamiya, 1969; Schwartz, 1976). It has been empirically and consistently demonstrated that it is possible to consciously and predictably elicit certain physiological states (as measured by the EEG record) by selectively focusing on functions of the central nervous system (muscle relaxation, breathing) or particular thoughts. (Barber, 1971; Budzynski, Stoyva & Adler, 1970; Caha, 1976; Dicara, 1970; Foulkes, 1965; Foulkes & Vogel, 1966; Green, Green & Walters, 1970; Hord, 1972; Jacobson, 1973; Honorton, Davidson & Bindler, 1972; Kamiya, 1969; Kimmell, 1967; Luthé & Geissman, 1963; Miller, 1969; Mulholland & Runnals, 1962; Nowlis & Kamiya, 1970; Paskewitz, Orne & Castello, 1970; Schwartz, Davidson & Pugash, 1976; Sheer, 1972; Sittenfeld, 1972).

The two predominant methods for facilitating desired physiological states (and thus fostering certain mental-emotional

states) are Autogenic Training (Green, Green & Walters, 1977), and Progressive Relaxation (Jacobson, 1973). Both of these techniques require the subject to selectively attend to specific central nervous system functions (muscle relaxation) or particular thoughts (of warmth, sleepiness, aesthetically pleasing subjects). These techniques were originally utilized for elimination or mitigation of inappropriate anxiety symptoms (Kamiya, 1962, 1967, 1968); however, it has been found that deep relaxation is associated with what has been described in subjects' reports as creative or insight states (Brown, 1977). These relaxation techniques are in essence, an extension of gross and fine muscle pattern learning (learning a sport or learning to draw, etc.). It has been discovered that when subjects succeeded in producing the alpha EEG pattern, not only were the anxiety symptoms allayed, but the subjects reported shifts in cognitive styles and affective states. These states appeared to be closely related to insight states reported by creatively-productive individuals (Brown, 1977; Green, Green & Walters, 1977). The utilization of conscious elicitation of particular EEG patterns for the purpose of facilitating the cognitive and affective states associated with creativity is currently an area of active research (Green, Green & Walters, 1970; Honorton, Davidson & Bindler, 1972; Horz, Lubin & Johnson, 1975; Nowlis & Kamiya, 1970; Schwartz, Davidson & Pugash, 1976; Sittenfeld, 1972), and points to the possibility of assisting the individual in improving his/her own internal (cognitive-affective) environment and thus perhaps facilitating his/her own predisposition toward "creativity" states.

The Psychophysiological Model of Problem-Solving

In 1926, Graham Wallas proposed a 4-stage model of creativity inspired by the eminent German physicist Helmholtz's accounts of the subjective experiences he had encountered while realizing his greatest insights (Vernon, 1976.) According to Wallas (1926), the creative thinking process consisted of four distinguishable, although overlapping stages. These four stages were:

- (1) Preparation: the problem was investigated in all directions.
- (2) Incubation: the individual was not consciously thinking about the problem.
- (3) Illumination: the appearance of the "happy idea" together with the psychological events which immediately preceded and accompanied the appearance of the happy idea.

(4) Verification: the individual then judges the truth of the solution or product (p. 80).

It is the opinion of this writer that there are both hemispheric and psychophysiological (EEG) correlates to Wallas' four stages of creative thinking which are incorporated in the "psychophysiological model of problem-solving." The theoretical bridge between Wallas' creativity model and the findings of psychophysiological research is provided by the theory of "action and receptive modes" proposed by Deikman (1971). The "action mode," is a state of cortical arousal (awareness) organized to manipulate the environment and acquire knowledge in order to change the environment. The focus of attention is external and the corresponding physiological indices of the "action mode" are the beta EEG pattern and increased baseline muscle tension. This "action mode" appears to correspond to Wallas' preparation and verification stages in which external focus and reality testing functions are required which are primarily left hemisphere functions. In contrast, the receptive mode is a state which facilitates the intake of the environment rather than the manipulation of the environment. The psychophysiological concomitants of the "receptive mode" are the alpha or theta EEG patterns and decreased muscle tension. Right hemisphere processes appear to be predominantly involved in the "receptive mode." It is hypothesized by Deikman (1971) that it is during this receptive state or when the person discontinues to focus consciously on a problem and directs his/her attention to other things, that solutions to problems manifest themselves as an "Aha!", "Eureka!" or "insight experience." This receptive mode could be interpreted as being analogous to Wallas' incubation and illumination stages where attention to the problem is defocused, and solutions or insights to problems spontaneously appear.

Training for Problem-Solving

A systematic approach to facilitating problem-solving skills could be designed as follows: First, mastery of an appropriate relaxation technique such as Progressive Relaxation (Jacobson, 1973) or Autogenic Training (Green, Green & Walters, 1977) would be achieved. (These relaxation techniques could be incorporated into physical education curricula). Once the individual demonstrated the ability to consistently elicit a particular state of relaxation as indicated by physiological measures (determined by the EEG pattern frequency (theta, alpha and beta states), the electromyogram (EMG), a graphic recording of skeletal muscle states associated with

relaxation, or the Galvanic Skin Response (GSR), the measure of skin conductivity for minute electrical currents based on skin moisture related to varying states of relaxation (Brown, 1977), training for transfer to "real life" situations would be undertaken (Wolpe, 1969). According to the "psychophysiological model of problem solving", the following strategies would be employed according to the stages suggested by Wallas (1926):

The preparatory stage. In this stage, which corresponds to Deikman's (1971) "action mode", a general state of relaxation as indicated by a high alpha or low beta EEG pattern (10 - 12 Hz.) would be brought about. It has been substantially concluded that there is a generally positive correlation between general problem-solving ability and measured (utilizing various physiological indices such as the EEG) or reported levels of relaxation (Bodi, 1970; Carlson, 1969; Frost, 1969; Harper, 1971; Mandler, 1962; Mann et al., 1968; Proger, 1969; Pulvino, 1972; Sarason, 1964.)

The incubation stage. This stage is similar to Deikman's (1971) "receptive stage." Attention would be focused inwardly, and a deeper state of relaxation would be attained. This deeper state of relaxation would be determined by the elicitation of the alpha (8.0 - 13.5 Hz.) EEG pattern. The individual would be instructed to produce as many solutions to the given problem without any evaluation as to their merit or practicality.

The illumination stage. The illumination stage also corresponds to Deikman's (1971) receptive mode, and would be characterized by a very deep state of relaxation reflected in the 3.5 - 7.5 Hz. theta EEG pattern. No conscious effort to focus on the problem would be attempted. Thoughts would be allowed to flow freely.

Verification. The individual would shift his/her focus of attention externally, and would again enter Deikman's "action mode." A normal state of alertness would be attained, which would be indicated by the high alpha or low beta (10 - 12 Hz.) EEG pattern. Evaluation of the products with respect to practicality and adherence to the initial goals of the problem-solving exercise would take place at this stage.

In essence, according to the psychophysiological model of problem-solving, it would be possible to more operationally define the cognitive and affective modes that would be most appropriate for

the type of problem encountered. That is, through psychophysiological research it were determined that particular physiological states (as indicated by the EEG or other physiological measures) were more conducive to the occurrence of a more creative or receptive mode, individuals could be taught how to replicate that psychophysiological state and thus produce the corresponding cognitive or affective state.

According to the proposed psychophysiological model of problem solving, it is hypothesized that appropriate shifts in the quality and focus of attention (from external to internal and vice-versa) could be consciously elicited through the mastery of systematic relaxation techniques. Consequently, it would be possible that the most advantageous cognitive or affective modes could be brought about apropos to the stage of problem-solving at hand. Furthermore, if the psychophysiological profiles of the most successful problem-solvers could be provided for replication by others, just as observable behavioral patterns of the most renowned musicians, artists and athletes have been emulated for centuries by aspiring novices, the psychophysiological patterns found to best facilitate problem-solving might be practiced just as a sonata is practiced to obtain mastery of the piano. This type of "practice" would involve what Wallas (1926) termed the "self-training of one's natural thought processes" (p. 79). If the creative or problem-solving process could be operationally defined according to quantifiable physiological parameters, perhaps this process could be utilized within the framework of creativity training models which are in use today e.g., "brainstorming" (Osborn, 1963; Parnes & Harding, 1962), "the Mindspring Theory" (Prince, 1976), to greatly increase the chances of generating solutions to heretofore unresolved problems.

Summary

Despite the fact that information about the functional organization of the cerebral hemispheres has been collected for over a century (Eccles, 1973), the advent of non-intrusive, psychophysiological methods of investigation (EEG, dichotic listening tasks, visual field and saccadic eye movement observation) has greatly accelerated the understanding of the "bifunctional brain" (Ornstein, 1978). A review of representative studies and theoretical literature on hemispheric functioning suggests that the following functions are localized in the right hemisphere: For left-handed adults and children approximately five years of age or under, language processing is more equally divided between the right and

left hemispheres. The right hemisphere is more involved than the left hemisphere with the interpretation and retention of complex non-verbal visual and auditory patterns such as the recognition of facial features or recall of melodic patterns. The right hemisphere is predominant in processing the "artistic subjects" (music, art, dance, and physical education), and is theorized to be most adroit at processing tasks that require simultaneous and divergent cognitive styles. The right hemisphere appears to be relatively more involved with affective responses than the left hemisphere. Emotional responses which result from aesthetic evaluation or perceptions are hypothesized to be products of the right hemisphere.

Although the brain is "bifunctional", as substantiated by research on left and right hemispheric information processing styles and capacities, the most productive and creative intellectual functioning is theorized to occur when there is cooperation between hemispheres. In fact, early (before six or seven years of age) and extensive emphasis on the development of processing skills of either the right or left hemisphere to the neglect of the other can possibly lead to permanent cognitive (Passow, 1964; Rennels, 1976; Yakovlev, 1967) or affective (Crinella, Heck & Robinson, 1971) deficits. It has been found that educational experiences that were specifically designed to enhance right hemispheric processing (problem-solving skills) also improved performance on tasks considered to involve left hemispheric functions (verbal tasks) (Noller & Parnes, 1972; Samples, 1975). The results of EEG studies suggest that performance on tasks calling upon primarily left hemispheric (verbal) processing is improved when the right hemisphere is drawn into play (Kraft, 1976; Norman, 1977). Furthermore, it has been suggested that creative geniuses are most adroit at utilizing both the left and the right hemispheric processing modes (Ghiselin, 1952; Gilchrist, 1970; Kraft, 1976; Norman, 1977).

Through the use of the electroencephalogram (EEG) (the graphic recording of the measurement of the electrical potential associated with brain activity) (Hinsie & Campbell, 1960), some of the physiological correlates of cognitive and affective functioning are being identified. Through the "science of subjective experience" (Davidson & Krippner, 1971) these findings concerning physiological correlates of mental activity are being utilized to establish "information processing models" which are amenable to empirical investigation. Reciprocal relationships between physiological and mental modes have been incorporated into what Green, Green and

Walters (1970) have termed "the psychophysiological principle." In the "psychophysiological principle" it is posited that certain physiological measures vary predictably as a function of particular cognitive and affective modes. Most importantly, those particular cognitive and affective modes can be elicited by producing the physiological state associated with those cognitive and affective states through systematic relaxation training techniques such as Autogenic Training (Green, Green & Walters, 1977) or Progressive Relaxation (Jacobson, 1973).

The results or research findings on hemispheric and psychophysiological correlates of information processing have been presented herein with Wallas, (1926) four-stage theory of creativity in order to develop the "psychophysiological model of problem-solving." In this proposed model, the physiological indices which appear to be closely associated with Wallas' four stages of creativity (preparation, incubation, illumination, verification) are presented in terms of empirically quantifiable physiological measures (EEG patterns). Therefore, the possibility of an operationally defined sequence for problem-solving is posited as an outcome of the proposed model. It is further hypothesized that via systematic relaxation training techniques, conscious elicitation of the various physiological states associated with each of the problem-solving stages can be attained, and more effective problem-solving can be made possible. It is also suggested that this proposed "psychophysiological model of problem-solving," could be adapted to existing creativity training models, such as "brainstorming" (Parnes & Harding, 1962) to ascertain physiological aspects of these training models, and thus perhaps more operationally define and increase the replicability of successful creativity training and problem-solving strategies.

Through the psychophysiological approach to learning and problem-solving more precise learning and problem-solving paradigms could be constructed. This greater precision in developing learning and problem-solving paradigms could be accomplished because the influence of subject variables such as test anxiety, attitudes and cultural background of the subject, etc., would be either mitigated or more accurately accounted for as the result of a more direct measure of these influences.

Psychophysiological profiles of the most effective learners or problem-solvers could be provided for replication by other in-

dividuals just as the observable performances of outstanding musicians or athletes are studied and practiced by apprentices. Thus, the development of outstanding problem-solvers could be nurtured with the hope of increasing the chances of creative genius.

REFERENCE NOTE

Contact the author for the complete review of the representative hemisphericity literature, which contains details on the studies reviewed and conclusions regarding the functional organization of both hemispheres.

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* Indicates those references used in the article "The Role of the Right Hemisphere in Learning and Creativity: Implications for Enhancing Problem Solving Ability".

*Solomon H. Katz, speaking of right hemispheric thought processes: "Certainly, the absolutely abundant anthropological evidence that supports their manifestations from the intuitive perspective indicates that our implicit knowledge of these phenomena may be as old as humanity itself. But what is different and truly exciting this time is that we can now begin to use the knowledge as a regular part of our scientific understanding of the human mind in order to extend further our means of adapting to the world we live in At last, our newly developing science of humanity can potentially set us free to recognize that there is more to humanity than all of our linear thinking can give us and to realize that human life viewed predominantly from left hemisphere functions is almost as flat as viewing the world through one eye."
